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Interpoll Laboratories, Inc.

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RESULTS OF THE JUNE 28 & 29, 1994 AIR EMISSION COMPLIANCE TESTS AT THE LOUISIANA PACIFIC OSB PLANT IN DUNGANNON, VIRGINIA

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ABBREVIATIONS

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

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

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1 INTRODUCTION

On June 28 & 29, 1994 Interpoll Laboratories personnel conducted air emission compliance tests on the following sources at the Louisiana Pacific Corporation (LP) OSB Plant located in Dungannon, Virginia.

Source	Parameters
Thermal Oil Heater Stack	PM,PM-10
Dryer Stack	PM,NO_x,CO,CH_2O,THC's
Press Vent Stack	CH_2O,THC's,Phenol,MDI

On-site testing was performed by Ed Trowbrige, Mark Kaehler, Ken Rosenthal, and Dennis Marso. Coordination between testing activities and plant operation was provided by Sue Somers of LP. The tests were witnessed by Stanley Faggert and Glenn Diehl of the Virginia Department of Air Pollution Control Commonwealth of Virginia.

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 10^6BTU/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, 1993). 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.

PM-10 sampling was conducted in accordance with EPA Method 201A (CFR Title 40, 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.

The oxides of nitrogen samples (Runs 2 & 3) were collected 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.

Oxides of Nitrogen (Run 1 ONLY) and carbon monoxide determinations were performed in accordance with EPA Method 7E and 10. A slip stream of sample gas was withdrawn from the exhaust gas stream using a heated stainless steel probe equipped with a filter to remove interfering particulate material. The particulate-free gas was transported to the analyzers by means of a heat-traced probe and filter assembly. After passing through the filter, the gas passed through a chilled condenser-type moisture removal system. The particulate-free dry gas was then transported to the analyzers with the excess exhausted to the atmosphere through a calibrated orifice which was used to ensure that the flow from the stack exceeds the requirements of the analyzers. A three-way valve on the probe was used to introduce standard gas for the "system bias check".

The analog response of the oxides of nitrogen analyzer was recorded with a strip chart recorder. The analyzer was calibrated with Scott Specialty, National Specialty, and Linde Gases (EPA Protocol 1) and Certified Master standard gases. The instrument was calibrated before and after each run as per EPA Method 7E and 10. The sample probe was moved through a three-point traverse (1/6, 3/6, 5/6 of the stack diameter) to measure oxides of nitrogen concentrations.

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

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

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 d6 and 59.8 mg of 2-fluorophenol.

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. 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 simultaneously with each of the above-referenced sampling trains at the dryer and thermal oil heater test sites using a specially designed gas sampling system. Integrated flue gas samples were collected in 44-liter Tedlar bags housed in a protective aluminum container. After sampling was complete, the bags were sealed and returned to the laboratory for Orsat analysis. Prior to sampling, the Tedlar bags are leak checked at 15 IN.HG. vacuum with an in-line rotameter. Bags with any detectable inleakage are discarded.

Testing on the 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 Thermal Oil Heater 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 73 to 75 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 results of the air emission compliance tests are summarized in Tables 1 - 9. An overview of the results is presented in the Table below:

PARAMETER		MEASURED
Thermal Oil Heater		
Particulate		
	(GR/DSCF)	0.018
	(LB/HR)	2.8
	(LB/10^6BTU)	0.23
PM-10		
	(GR/DSCF)	0.0083
	(LB/HR)	1.3
	(LB/10^6BTU)	0.11
Dryer Stack		
Particulate		
	(GR/DSCF)	0.056
	(LB/HR)	16
Oxides of Nitrogen		
	(ppm,d)	21
	(LB/HR)	3.2
Carbon Monoxide		
	(ppm,d)	257
	(LB/HR)	38
Total Hydrocarbons		
	(ppmC,w)	41
	(LB/HR)	3.2
Formaldehyde		
	(ppm,d)	4
	(LB/HR)	0.62

PARAMETER	MEASURED
Press Vent Stack	
Formaldehyde	
. . . . (ppm,d)	3
. . . . (LB/HR)	1.2
Total Hydrocarbons	
. . . . (ppmC,w)	24
. . . . (LB/HR)	3.4
Phenol	
. . . . (ppm,d)	< 170
. . . . (LB^{-3}/HR)	< 187
MDI (NITRO)	
. . . . (ppm,d)	0.0218
. . . . (LB/HR)	0.0634
MDI (1,2-PP)	
. . . . (ppm,d)	0.0140
. . . . (LB/HR)	0.0412

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

Table 1a Summary of the Results of the June 28, 1994 Particulate Emission Test of the Thermal Oil Heater at the Louisiana Pacific Plant in Dungannon, Virginia.

ITEM		Run 1	Run 2	Run 3
Date of test		06-28-94	06-28-94	06-28-94
Time runs were done	(HRS)	830/ 935	1005/1112	1137/1243
Volumetric flow				
actual	(ACFM)	29294	28689	28007
standard	(DSCFM)	18868	18252	17957
Gas temperature	(DEG-F)	286	288	289
Moisture content	(%V/V)	5.20	6.07	5.21
Gas composition	(%V/V,dry)			
carbon dioxide		2.20	2.00	2.10
oxygen		18.60	18.80	18.80
nitrogen		79.20	79.20	79.10
Isokinetic variation	(%)	97.8	99.1	98.5
Particulate concentration				
actual	(GR/ACF)	.0133	.0121	.00843
standard	(GR/DSCF)	.0207	.0191	.0131
Part. emission rate	(LB/HR)	3.34	2.98	2.02
	(LB/TFP)	0.36	0.32	0.22
Emission factor	(LB/MMBTU)	0.257	0.260	0.179

Note: Dry + Method 202 Condensible Particulate Material

TFP = Ton Finished Product (9.25 TON/HR 6-28-94)

Table 1b Summary of the Results of the June 28, 1994 Particulate Emission Test of the Thermal Oil Heater at the Louisiana Pacific Plant in Dungannon, Virginia.

ITEM		Run 1	Run 2	Run 3	
Date of test		06-28-94	06-28-94	06-28-94	
Time runs were done	(HRS)	830/ 935	1005/1112	1137/1243	
Volumetric flow					
actual	(ACFM)	29294	28689	28007	
standard	(DSCFM)	18868	18252	17957	
Gas temperature	(DEG-F)	286	288	289	
Moisture content	(%V/V)	5.20	6.07	5.21	
Gas composition	(%V/V,dry)				
carbon dioxide		2.20	2.00	2.10	
oxygen		18.60	18.80	18.80	
nitrogen		79.20	79.20	79.10	
Isokinetic variation	(%)	97.8	99.1	98.5	
Particulate concentration					
actual	(GR/ACF)	.00813	.00757	.00625	
standard	(GR/DSCF)	.0126	.0119	.00976	
Part. emission rate	(LB/HR)	2.04	1.86	1.50	1.80
	(LB/TFP)	0.22	0.20	0.16	
Emission factor	(LB/MMBTU)	0.157	0.162	0.133	

~~Note: Dry Catch Only~~

Table 2a Summary of the Results of the June 28, 1994 Particulate Emission Test of the Dryer Stack at the Louisiana Pacific Plant in Dungannon, Virginia.

ITEM	Run 1	Run 2	Run 3
Date of test	06-28-94	06-28-94	06-28-94
Time runs were done (HRS)	1426/1529	1641/1742	1813/1915
Volumetric flow			
actual (ACFM)	52333	54677	54419
standard (DSCFM)	32628	34794	33658
Gas temperature (DEG-F)	206	203	203
Moisture content (%V/V)	18.23	16.91	19.23
Gas composition (%V/V,dry)			
carbon dioxide	2.70	2.70	2.80
oxygen	18.20	18.20	18.10
nitrogen	79.10	79.10	79.10
Isokinetic variation (%)	104.8	99.4	103.1
Particulate concentration			
actual (GR/ACF)	.0438	.0273	.0348
standard (GR/DSCF)	.0702	.0429	.0563
Part. emission rate (LB/HR)	19.64	12.81	16.25
(LB/TFP)	2.05	1.34	1.70

53809
33693

Note: Dry + Method 202 Condensible Particulate Material

TFP = Ton Finished Product (9.56 TON/HR 6-28-94)

Table 2b Summary of the Results of the June 28, 1994 Particulate Emission Test of the Dryer Stack at the Louisiana Pacific Plant in Dungannon, Virginia.

ITEM		Run 1	Run 2	Run 3
Date of test		06-28-94	06-28-94	06-28-94
Time runs were done	(HRS)	1426/1529	1641/1742	1813/1915
Volumetric flow				
actual	(ACFM)	52333	54677	54419
standard	(DSCFM)	32628	34794	33658
Gas temperature	(DEG-F)	206	203	203
Moisture content	(%V/V)	18.23	16.91	19.23
Gas composition	(%V/V,dry)			
carbon dioxide		2.70	2.70	2.80
oxygen		18.20	18.20	18.10
nitrogen		79.10	79.10	79.10
Isokinetic variation	(%)	104.8	99.4	103.1
Particulate concentration				
actual	(GR/ACF)	.0351	.0234	.0251
standard	(GR/DSCF)	.0563	.0368	.0407
Part. emission rate	(LB/HR)	15.74	10.97	11.73
	(LB/TFP)	1.65	1.15	1.23

Note: Dry Catch Only

Table 3. Summary of the Results of the June 28, 1994 PM-10 Determination Test on the Thermal Oil Heater Stack at the Louisiana Pacific Corporation Plant Located in Dungannon, Virginia.

ITEM		Run 1	Run 2	Run 3
Date of test		06-28-94	06-28-94	06-28-94
Time runs were done	(HRS)	1355/1512	1530/1646	1703/1818
Volumetric flow				
actual	(ACFM)	28510	28519	28317
standard	(DSCFM)	18173	18099	18139
Gas temperature	(DEG-F)	288	288	286
Moisture content	(%V/V)	5.88	6.26	5.68
Gas composition	(%V/V,dry)			
carbon dioxide		2.70	1.90	2.30
oxygen		18.10	19.00	18.60
nitrogen		79.20	79.10	79.10
Isokinetic variation	(%)	88.1	89.5	89.2
PM-10 Concentration				
actual	(GR/ACF)	.00394	.00770	.00422
standard	(GR/DSCF)	.00618	.0121	.00660
PM-10 Emission Rate	(LB/HR)	0.963	1.88	1.03
	(LB/TFP)	0.101	0.197	0.108
Emission factor	(LB/MMBTU)	0.063	0.183	0.082

1.29

Note: Dry Catch Only

TFP = Ton Finished Product (9.53 TON/HR 6-28-94)

Table 4. Summary of the Results of the June 28, 1994 **Oxides of Nitrogen** Emission Compliance Tests at the Louisiana Pacific Plant in Dungannon, Virginia.

Time	Concentration (ppm,d)	Emission Rate (LB/HR)	Emission Rate (LB/TFP)
(Dryer Stack)			
1810-1910	18	2.8	0.30
2040-2140	37	5.7	0.61
2150-2250	7	1.1	0.12
Avg	21	3.2	0.34

TFP = Ton Finished Product (9.34 TON/HR 6-28-94)

Table 5. Summary of the Results of the June 28, 1994 **Carbon Monoxide** Emission Compliance Test of the **Dryer Stack** at the Louisiana Pacific Plant in Dungannon, Virginia.

Time	Concentration (ppm,d)	Emission Rate (LB/HR)	 (LB/TFP)
1230-1331	157	24	2.5
1425-1530	269	38	4.0
1642-1743	346	52	5.4
Avg.	257	38	4.0

TFP = Ton Finished Product (9.59 TON/HR 6-28-94)

Table 6. Summary of the June 28 & 29, 1994 **Formaldehyde** Emission Compliance Tests at the Louisiana Pacific Plant in Dungannon, Virginia.

Time	Concentration (ppm,d)	Emission Rate (LB/HR)	Emission Rate (LB/TFP)
(Dryer Stack 6-28-94)			
0850-0951	2	0.41	0.044
1025-1127	6	0.96	0.104
1200-1302	3	0.49	0.053
Avg.	4	0.62	0.067
(Press Vent Stack 6-29-94)			
1547-1700	4	1.3	0.14
1719-1832	3	1.1	0.11
1848-2001	3	1.2	0.12
Avg.	3	1.2	0.12

TFP = Ton Finished Product (9.25 TON/HR Dryer, 9.61 TON/HR Press)

Table 7. Summary of the June 29, 1994 **MDI** Emission Compliance Test on the **Press Vent Stack** at the Louisiana Pacific Plant in Dungannon, Virginia.

Time	Concentration (ppm,d)	Emission Rate (LB/HR)	Emission Rate (LB/TFP)
(1,2-PP Method)			
0905-1009	0.0160	0.0469	0.0049
1101-1203	0.0156	0.0459	0.0048
1244-1347	0.0105	0.0309	0.0032
Avg.	0.0140	0.0412	0.0043
(Nitro Method)			
0905-1009	0.0253	0.0727	0.0076
1101-1203	0.0238	0.0691	0.0073
1244-1347	0.0164	0.0484	0.0051
Avg.	0.0218	0.0634	0.0067

TFP = Ton Finished Product (9.53 LB/HR 6-29-94)

Table 8. Summary of the June 29, 1994 **Phenol Emission Compliance Test** on the **Press Vent Stack** at the Louisiana Pacific Plant in Dungannon, Virginia.

Time	Concentration (ppb,d)	Emission Rate (10^{3}LB/HR)	Emission Rate (LB^{-3}/TFP)
1548-1649	< 170	< 184	< 19
1720-1822	< 171	< 188	< 20
1827-1927	< 170	< 190	< 20
Avg	< 170	< 187	< 20

TFP = Ton Finished Product (9.61 TON/HR 6-29-94)

Table 9. Summary of the June 28 & 29, 1994 **Total Hydrocarbon** Emission Compliance Tests at the Louisiana Pacific Plant in Dungannon, Virginia.

Time	As Carbon Concentration (ppm,d)	Emission Rate (LB/HR)	Emission Rate (LB/TFP)
(Dryer Stack 6-28-94)			
1230-1331	40	3.1	0.32
1425-1530	58	4.3	0.45
1642-1743	26	2.0	0.21
Avg.	41	3.2	0.33
(Press Vent Stack 6-29-94)			
0904-1033	18	2.6	0.27
1059-1204	19	2.7	0.28
1243-1348	34	5.0	0.52
Avg.	24	3.4	0.36

TFP = Ton Finished Product (9.56 TON/HR Dryer, 9.53 TON/HR Press Vent)

3 RESULTS

The results of all field and laboratory evaluations are presented i 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, MDI, and phenol 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	06-28-94	06-28-94	06-28-94
Dry basis (orsat)			
carbon dioxide............	2.20	2.00	2.10
oxygen....................	18.60	18.80	18.80
nitrogen..................	79.20	79.20	79.10
Wet basis (orsat)			
carbon dioxide............	2.09	1.88	1.99
oxygen....................	17.63	17.66	17.82
nitrogen..................	75.08	74.39	74.98
water vapor...............	5.20	6.07	5.21
Dry molecular weight........	29.10	29.07	29.09
Wet molecular weight........	28.52	28.40	28.51
Specific gravity............	0.985	0.981	0.985
Water mass flow......(LB/HR)	2901	3310	2766
FO	1.045	1.050	1.000

Test No. 2
Dryer Stack

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

	Run 1	Run 2	Run 3
Date of run	06-28-94	06-28-94	06-28-94
Dry basis (orsat)			
carbon dioxide............	2.30	2.30	2.10
oxygen....................	18.60	18.60	18.90
nitrogen..................	79.10	79.10	79.00
Wet basis (orsat)			
carbon dioxide............	1.98	1.94	1.81
oxygen....................	15.98	15.72	16.33
nitrogen..................	67.94	66.87	68.28
water vapor...............	14.11	15.46	13.57
Dry molecular weight........	29.11	29.11	29.09
Wet molecular weight........	27.54	27.39	27.59
Specific gravity............	0.951	0.946	0.953
Water mass flow......(LB/HR)	0.00	0.00	0.00
FO	1.000	1.000	0.952

Test No. 3
Thermal Oil Heater Stack

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

	Run 1	Run 2	Run 3
Date of run	06-28-94	06-28-94	06-28-94
Dry basis (orsat)			
carbon dioxide............	2.70	1.90	2.30
oxygen....................	18.10	19.00	18.60
nitrogen..................	79.20	79.10	79.10
Wet basis (orsat)			
carbon dioxide............	2.54	1.78	2.17
oxygen....................	17.04	17.81	17.54
nitrogen..................	74.54	74.15	74.61
water vapor...............	5.88	6.26	5.68
Dry molecular weight........	29.16	29.06	29.11
Wet molecular weight........	28.50	28.37	28.48
Specific gravity............	0.984	0.980	0.984
Water mass flow......(LB/HR)	3183	3388	3061
FO	1.037	1.000	1.000

Test No. 6
Dryer Stack

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

	Run 1	Run 2	Run 3
Date of run	06-28-94	06-28-94	06-28-94
Dry basis (orsat)			
carbon dioxide............	2.70	2.70	2.80
oxygen....................	18.20	18.20	18.10
nitrogen..................	79.10	79.10	79.10
Wet basis (orsat)			
carbon dioxide............	2.21	2.24	2.26
oxygen....................	14.88	15.12	14.62
nitrogen..................	64.68	65.73	63.89
water vapor...............	18.23	16.91	19.23
Dry molecular weight........	29.16	29.16	29.17
Wet molecular weight........	27.13	27.27	27.02
Specific gravity............	0.937	0.942	0.933
Water mass flow......(LB/HR)	20404	19857	22476
FO	1.000	1.000	1.000

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	06-29-94	06-29-94	06-29-94
Dry basis (orsat)			
carbon dioxide............	0.03	0.03	0.03
oxygen....................	20.90	20.90	20.90
nitrogen..................	79.07	79.07	79.07
Wet basis (orsat)			
carbon dioxide............	0.03	0.03	0.03
oxygen....................	20.06	20.21	20.28
nitrogen..................	75.89	76.46	76.72
water vapor...............	4.03	3.30	2.97
Dry molecular weight........	28.84	28.84	28.84
Wet molecular weight........	28.40	28.48	28.52
Specific gravity............	0.981	0.984	0.985
Water mass flow......(LB/HR)	0.00	0.00	0.00

Test No. 8
Press Vent Stack

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

	Run 1	Run 2	Run 3
Date of run	06-29-94	06-29-94	06-29-94
Dry basis (orsat)			
carbon dioxide............	0.03	0.03	0.03
oxygen....................	20.90	20.90	20.90
nitrogen..................	79.07	79.07	79.07
Wet basis (orsat)			
carbon dioxide............	0.03	0.03	0.03
oxygen....................	20.16	20.00	20.36
nitrogen..................	76.27	75.66	77.03
water vapor...............	3.55	4.32	2.57
Dry molecular weight........	28.84	28.84	28.84
Wet molecular weight........	28.46	28.37	28.56
Specific gravity............	0.983	0.980	0.987
Water mass flow......(LB/HR)	0.00	0.00	0.00

Test No. 11
Press Vent Stack

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

	Run 1	Run 2	Run 3
Date of run	06-29-94	06-29-94	06-29-94
Dry basis (orsat)			
carbon dioxide............	0.03	0.03	0.03
oxygen....................	20.90	20.90	20.90
nitrogen..................	79.07	79.07	79.07
Wet basis (orsat)			
carbon dioxide............	0.03	0.03	0.03
oxygen....................	20.32	20.29	20.40
nitrogen..................	76.89	76.76	77.19
water vapor...............	2.76	2.92	2.38
Dry molecular weight........	28.84	28.84	28.84
Wet molecular weight........	28.54	28.52	28.58
Specific gravity............	0.986	0.985	0.987
Water mass flow......(LB/HR)	0.00	0.00	0.00

3.2 Results of Particulate Determinations

Test No. 1
Thermal Oil Heater Stack

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

	Run 1	Run 2	Run 3
Date of run	06-28-94	06-28-94	06-28-94
Time run start/end.....(HRS)	830/ 935	1005/1112	1137/1243
Static pressure......(IN.WC)	-0.20	-0.20	-0.20
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)	35.0	38.0	40.0
desiccant..........(GRAMS)	16.0	21.0	9.0
total..............(GRAMS)	51.0	59.0	49.0
Total particulate material..			
..........collected(grams)	0.0587	0.0531	0.0359
Gas meter coefficient.......	0.9961	0.9961	0.9961
Barometric pressure..(IN.HG)	28.72	28.72	28.72
Avg. orif.pres.drop..(IN.WC)	1.57	1.55	1.51
Avg. gas meter temp..(DEF-F)	76.5	90.4	100.7
Volume through gas meter....			
at meter conditions...(CF)	46.45	46.75	46.56
standard conditions.(DSCF)	43.87	43.03	42.07
Total sampling time....(MIN)	64.00	64.00	64.00
Nozzle diameter.........(IN)	.250	.250	.250
Avg.stack gas temp ..(DEG-F)	286	288	289
Volumetric flow rate........			
actual..............(ACFM)	29294	28689	28007
dry standard.......(DSCFM)	18868	18252	17957
Isokinetic variation.....(%)	97.8	99.1	98.5
Particulate concentration...			
actual...........(GR/ACF)	0.01330	0.01212	0.00843
dry standard.....(GR/DSCF)	0.02066	0.01906	0.01315
Particle mass rate...(LB/HR)	3.341	2.981	2.024
F-factor ....(DSCF/MMBTU)	9600	9600	9600
Emission factor...(LB/MMBTU)	0.257	0.260	0.179

Test No. 6
Dryer Stack

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

	Run 1	Run 2	Run 3
Date of run	06-28-94	06-28-94	06-28-94
Time run start/end.....(HRS)	1426/1529	1641/1742	1813/1915
Static pressure......(IN.WC)	0.73	0.73	0.73
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)	135.0	124.0	148.0
desiccant..........(GRAMS)	9.0	9.0	8.0
total..............(GRAMS)	144.0	133.0	156.0
Total particulate material.. ....collected(grams)	0.1386	0.0858	0.1128
Gas meter coefficient.......	0.9997	0.9997	0.9997
Barometric pressure..(IN.HG)	28.72	28.72	28.73
Avg. orif.pres.drop..(IN.WC)	0.90	0.93	0.92
Avg. gas meter temp..(DEF-F)	101.9	102.5	102.8
Volume through gas meter....			
at meter conditions...(CF)	33.71	34.15	34.24
standard conditions.(DSCF)	30.45	30.82	30.90
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.........(IN)	.185	.185	.185
Avg.stack gas temp ..(DEG-F)	206	203	203
Volumetric flow rate........			
actual..............(ACFM)	52333	54677	54419
dry standard.......(DSCFM)	32628	34794	33658
Isokinetic variation.....(%)	104.8	99.4	103.1
Particulate concentration...			
actual............(GR/ACF)	0.04378	0.02732	0.03483
dry standard.....(GR/DSCF)	0.07024	0.04295	0.05633
Particle mass rate...(LB/HR)	19.645	12.809	16.251

3.3 Results of PM-10 Determinations

Test No. 3
Thermal Oil Heater Stack

Results of PM-10 Determinations ---------------------------

	Run 1	Run 2	Run 3
Date of run	06-28-94	06-28-94	06-28-94
Time run start/end.....(HRS)	1355/1512	1530/1646	1703/1818
Static pressure......(IN.WC)	-0.20	-0.20	-0.20
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)	33.0	27.0	34.0
desiccant..........(GRAMS)	9.0	18.0	6.0
total..............(GRAMS)	42.0	45.0	40.0
Total PM-10 material........ ....collected(grams)	0.0127	0.0250	0.0134
Gas meter coefficient.......	0.9961	0.9961	0.9961
Barometric pressure..(IN.HG)	28.72	28.72	28.72
Avg. orif.pres.drop..(IN.WC)	0.59	0.59	0.59
Avg. gas meter temp..(DEF-F)	104.2	104.4	99.5
Volume through gas meter....			
at meter conditions...(CF)	35.40	35.50	34.70
standard conditions.(DSCF)	31.71	31.79	31.35
Total sampling time....(MIN)	75.53	74.87	73.92
Nozzle diameter.........(IN)	.210	.210	.210
Avg.stack gas temp ..(DEG-F)	288	288	286
Volumetric flow rate........			
actual...............(ACFM)	28510	28519	28317
dry standard.......(DSCFM)	18173	18099	18139
Isokinetic variation.....(%)	88.1	89.5	89.2
PM-10 cutpoint..........(um)	9.94	9.88	9.83
PM-10 concentration.........			
actual............(GR/ACF)	0.00394	0.00770	0.00422
dry standard.....(GR/DSCF)	0.00618	0.01213	0.00660
PM-10 mass rate......(LB/HR)	0.963	1.882	1.026
F-factor ....(DSCF/MMBTU)	9600	9600	9600
Emission factor...(LB/MMBTU)	0.063	0.183	0.082

3.4 Results of Oxides of Nitrogen Determinations

Test No. 10
Dryer Stack

Results of Oxides of Nitrogen Determinations———————Method 7E

	Run 1
Date of run	6-29-94
Time run start/end (HRS)	1810-1910
Total sampling time (MIN)	60
Volumetric flow rate (DSCFM)	21610
NO_x concentration ppm,dry	18
NO_x emission rate (LB/HR)	2.8

Test No. 10
Dryer Stack

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

	Run 1A	Run 1B	Run 1C	Run 1D
Date of run................	06-29-94	06-29-94	06-29-94	06-29-94
Time of run............(HRS)	2052	2107	2122	2137
Flask number................	55	56	7	9
Volume of flask.........(ML)	2086	2069	2081	2080
Data: time of sampling				
flask temperature..(DEG-F)	74.00	74.00	74.00	73.00
bar. press.........(IN.HG)	28.62	28.62	28.62	28.62
flask vacuum.......(IN.HG)	26.35	26.70	26.75	26.60
flask abs. press...(IN.HG)	2.27	1.92	1.87	2.02
Data: Time of Flask Opening				
flask temperature..(DEG-F)	76.00	76.00	76.00	76.00
lab. bar. press....(IN.HG)	29.01	29.01	29.01	29.01
flask static press.(IN.HG)	-2.20	-1.40	-2.50	-0.60
flask abs. press...(IN.HG)	26.80	27.61	26.51	28.41
Volume gas sampled....(DSML)	1664	1727	1666	1784
Moisture content......(%V/V)	26.27	26.27	26.27	26.27
Nitrate in gas sample...(JG)	150.0	190.0	160.0	150.0
NO2 in gas sample.......(JG)	111.3	141.0	118.7	111.3
NOx Concentration				
(GR/DSCF)..................	0.0292	0.0357	0.0311	0.0273
(MG/DSCM)..................	67	82	71	62
(PPM-DRY)..................	35	43	37	33
(PPM-WET)..................	26	31	27	24
NOX Emission rate....(LB/HR)	5.42	6.61	5.77	5.05

Test No. 10
Dryer Stack

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

	Run 2A	Run 2B	Run 2C	Run 2D
Date of run................	06-29-94	06-29-94	06-29-94	06-29-94
Time of run............(HRS)	2156	2211	2226	2241
Flask number................	10	11	12	28
Volume of flask.........(ML)	2063	2062	2111	2031
Data: time of sampling				
flask temperature..(DEG-F)	73.00	73.00	72.00	72.00
bar. press.........(IN.HG)	28.62	28.62	28.62	28.62
flask vacuum.......(IN.HG)	26.65	26.75	26.80	26.75
flask abs. press...(IN.HG)	1.97	1.87	1.82	1.87
Data: Time of Flask Opening				
flask temperature..(DEG-F)	76.00	76.00	76.00	76.00
lab. bar. press....(IN.HG)	29.01	29.01	29.01	29.01
flask static press.(IN.HG)	-0.70	-0.50	-0.20	0.00
flask abs. press...(IN.HG)	28.30	28.51	28.80	29.01
Volume gas sampled....(DSML)	1766	1785	1852	1790
Moisture content......(%V/V)	26.27	26.27	26.27	26.27
Nitrate in gas sample...(JG)	38.0	34.0	30.3	33.0
NO2 in gas sample.......(JG)	28.2	25.2	22.5	24.5
NOx Concentration				
(GR/DSCF).................	0.0070	0.0062	0.0053	0.0060
(MG/DSCM).................	16	14	12	14
(PPM-DRY).................	8	7	6	7
(PPM-WET).................	6	5	5	5
NOX Emission rate....(LB/HR)	1.29	1.14	0.98	1.11

3.5 Results of Carbon Monoxide Determinations

Test No. 5
Dryer Stack

Results of Carbon Monoxide Determinations——————————Method 10

	Run 1	Run 2	Run 3
Date of run	6-28-94	6-28-94	6-28-94
Time run start/end (HRS)	1230-1331	1425-1530	1642-1743
Total sampling time (MIN)	60	60	60
Volumetric flow rate (DSCFM)	35770	32630	34790
CO concentration ppm,dry	157	269	346
CO emission rate (LB/HR)	24	38	52

3.6 Results of Formaldehyde Determinations

Test No. 2
Dryer Stack

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

	Run 1	Run 2	Run 3
Date of run	06-28-94	06-28-94	06-28-94
Time run start/end.....(HRS)	850/ 951	1025/1127	1200/1302
Static pressure......(IN.WC)	0.72	0.72	0.72
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)	168.0	186.0	157.0
desiccant..........(GRAMS)	14.0	18.0	17.0
total..............(GRAMS)	182.0	204.0	174.0
Formaldehyde in sample..(uG)	4390	10800	5400
Gas meter coefficient.......	0.9997	0.9997	0.9997
Barometric pressure..(IN.HG)	28.72	28.72	28.72
Avg. orif.pres.drop..(IN.WC)	2.58	2.68	2.66
Avg. gas meter temp..(DEF-F)	82.2	93.3	101.4
Volume through gas meter....			
at meter conditions...(CF)	55.57	57.08	57.51
standard conditions.(DSCF)	52.25	52.61	52.24
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.........(IN)	.239	.239	.239
Avg.stack gas temp ..(DEG-F)	194	203	205
Volumetric flow rate........			
actual..............(ACFM)	55431	54226	54177
dry standard.......(DSCFM)	36967	35101	35767
Isokinetic variation.....(%)	95.1	100.8	98.2
CH2O concentration..........			
(GR/DSCF).................	0.0013	0.0032	0.0016
(MG/DSCM).................	2.99	7.30	3.68
(PPM-DRY).................	2.39	5.85	2.94
(PPM-WET).................	2.06	4.94	2.55
CH2O emission rate...(LB/HR)	0.41333	0.95921	0.49215

CH2O = Formaldehyde

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

Test No. 11
Press Vent Stack

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

	Run 1	Run 2	Run 3
Date of run	06-29-94	06-29-94	06-29-94
Time run start/end.....(HRS)	1547/1700	1719/1832	1848/2001
Static pressure......(IN.WC)	-0.63	-0.63	-0.63
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)	12.0	22.0	17.0
desiccant..........(GRAMS)	19.0	11.0	10.0
total..............(GRAMS)	31.0	33.0	27.0
Formaldehyde in sample..(uG)	7080	5770	6140
Gas meter coefficient.......	0.9997	0.9997	0.9997
Barometric pressure..(IN.HG)	28.62	28.62	28.62
Avg. orif.pres.drop..(IN.WC)	1.79	1.81	1.85
Avg. gas meter temp..(DEF-F)	97.2	95.8	97.4
Volume through gas meter....			
at meter conditions...(CF)	56.53	56.74	57.44
standard conditions.(DSCF)	51.44	51.76	52.26
Total sampling time....(MIN)	72.00	72.00	72.00
Nozzle diameter.........(IN)	.184	.184	.184
Avg.stack gas temp ..(DEG-F)	97	96	97
Volumetric flow rate........			85158
actual..............(ACFM)	83897	85286	86291
dry standard.......(DSCFM)	73808	75033	76209
Isokinetic variation.....(%)	101.3	100.3	99.6
CH2O concentration..........			1.2165
(GR/DSCF).................	0.0021	0.0017	0.0018
(MG/DSCM).................	4.88	3.96	4.17
(PPM-DRY).................	3.91	3.17	3.34
(PPM-WET).................	3.80	3.08	3.26
CH2O emission rate...(LB/HR)	1.34920	1.11088	1.18942

CH2O = Formaldehyde

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

3.7 Results of MDI Determinations

Test No. 7
Press Vent Stack

Results of MDI Determinations.................................(NITRO)

	Run 1	Run 2	Run 3
Date of run	06-29-94	06-29-94	06-29-94
Time run start/end.....(HRS)	905/1009	1101/1203	1244/1347
Static pressure......(IN.WC)	-0.63	-0.63	-0.63
Cross sectional area (SQ.FT)	19.31	19.31	19.31
Pitot tube coefficient......	.840	.840	.840
Water in sample gas			
condenser.............(ML)	20.0	0.0	0.0
impingers..........(GRAMS)	0.0	0.0	0.0
desiccant..........(GRAMS)	19.0	31.0	28.0
total..............(GRAMS)	39.0	31.0	28.0
MDI in sample ....(ug)	326	301	209
Gas meter coefficient.......	0.9961	0.9961	0.9961
Barometric pressure..(IN.HG)	28.62	28.62	28.62
Avg. orif.pres.drop..(IN.WC)	1.81	1.76	1.84
Avg. gas meter temp..(DEF-F)	85.5	90.0	102.6
Volume through gas meter....			
at meter conditions...(CF)	47.30	46.70	48.05
standard conditions.(DSCF)	43.81	42.89	43.15
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.........(IN)	.185	.185	.185
Avg.stack gas temp ..(DEG-F)	96	102	103
Volumetric flow rate........			
actual..............(ACFM)	84876	85706	86949
dry standard.......(DSCFM)	73904	74419	75613
Isokinetic variation.....(%)	102.3	99.4	98.4
MDI Concentration ....(ppm,d)	0.0253	0.0238	0.0164
MDI Emission Rate.........(LB/HR)	0.0727	0.0691	0.0484

Test No. 8
Press Vent Stack

Results of MDI Determinations............................(1,2-PP Method)

	Run 1	Run 2	Run 3
Date of run	06-29-94	06-29-94	06-29-94
Time run start/end.....(HRS)	905/1009	1101/1203	1244/1347
Static pressure......(IN.WC)	-0.63	-0.63	-0.63
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)	10.0	17.0	12.0
desiccant..........(GRAMS)	24.0	25.0	12.0
total..............(GRAMS)	34.0	42.0	24.0
MDI in sample................(ug)	206	202	132
Gas meter coefficient.......	0.9997	0.9997	0.9997
Barometric pressure..(IN.HG)	28.62	28.62	28.62
Avg. orif.pres.drop..(IN.WC)	1.82	1.84	1.80
Avg. gas meter temp..(DEF-F)	88.1	91.2	100.5
Volume through gas meter....			
at meter conditions...(CF)	47.13	47.70	47.34
standard conditions.(DSCF)	43.60	43.88	42.82
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.........(IN)	.184	.184	.184
Avg.stack gas temp ..(DEG-F)	96	102	103
Volumetric flow rate........			
actual..............(ACFM)	85727	87734	86830
dry standard.......(DSCFM)	75017	75380	75816
Isokinetic variation.....(%)	101.4	101.5	98.5
MDI Concentration ....(ppm,d)	0.0160	0.0156	0.0105
MDI Emission Rate..........(LB/HR)	0.0469	0.0459	0.0309

3.8 Results of Phenol Determinations

Test No. 12
Press Vent Stack

Results of Phenol Determinations --------------------------

	Run 1	Run 2	Run 3
Date of run	06-29-94	06-29-94	06-29-94
Time run start/end.....(HRS)	1548/1649	1720/1822	1827/1927
Barometric pressure..(IN.HG)	28.62	28.62	28.62
Meter temperature....(DEG-F)	91.83	88.21	90.38
Meter correction coefficient	0.9961	0.9961	0.9961
Volume through gas meter....			
at meter conditions...(CF)	48.640	48.200	48.560
standard conditions (DSCF)	44.546	44.435	44.592
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content......(%V/V)	3.47	3.18	2.97
Volumetric flow rate (DSCFM)	73808	75033	76209
Phenol in sample........(uG)	840.00<	840.00<	840.00<
Phenol concentration........			
($GR/10^3DSCF$)..............	0.2910<	0.2917<	0.2907<
(uG/DSCM).................	666.40<	668.07<	665.72<
(PPB-DRY)................	170.29<	170.72<	170.12<
(PPB-WET)................	164.38<	165.29<	165.07<
Phenol emis. rate(10^{-3}LB/HR)	184.063<	187.588<	189.859<

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

Analysis performed according to NIOSH Method 3502

4 RESULTS OF FUEL ANALYSIS

INTERPOLL LABORATORIES, INC.
Fuel Laboratory
(612) 786-6020

8/1/94

Client: LOUISIANA PACIFIC/DUNGANNON, VA

Laboratory Log Number: 3252-42-7804

Sample Type: WOOD BARK

Ultimate Analysis WT %

Parameter	**Moisture & Ash Free**	**Moisture Free**	**As Received**
Moisture, Total			44.74
Ash		6.73	3.72
Carbon	59.41	55.41	30.62
Hydrogen	6.43	6.00	3.31
Nitrogen	0.59	0.55	0.30
Oxygen (calculated)	33.32	31.08	17.18
Sulfur	0.25	0.24	0.22
Heating Value, BTU/LB	9436	8801	4863

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Respectfully submitted,

Jeannie F. O

Jeannie F. O'Neil, Manager
Inorganic Chemistry Group

10523

APPENDIX A

VOLUMETRIC FLOW RATE DETERMINATIONS

Test No. 1
Thermal Oil Heater Stack

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

Date of Determination............	06-28-94
Time of Determination.......(HRS)	800
Barometric pressure.......(IN.HG)	28.72
Pitot tube coefficient...........	.84
Number of sampling ports.........	2
Total number of points...........	16
Shape of duct....................	Round
Stack diameter..............(IN)	41
Duct area.................(SQ.FT)	9.17
Direction of flow................	UP
Static pressure...........(IN.WC)	-.2
Avg. gas temp.............(DEG-F)	282
Moisture content..........(% V/V)	5.20
Avg. linear velocity.....(FT/SEC)	53.3
Gas density..............(LB/ACF)	.05056
Molecular weight......(LB/LBMOLE)	29.10
Mass flow of gas..........(LB/HR)	88872
Volumetric flow rate.............	
actual..................(ACFM)	29295
dry standard...........(DSCFM)	18960

Test No. 2
Dryer Stack

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

Date of Determination............	06-28-94
Time of Determination.......(HRS)	831
Barometric pressure.......(IN.HG)	28.72
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)	.72
Avg. gas temp.............(DEG-F)	194
Moisture content..........(% V/V)	14.11
Avg. linear velocity.....(FT/SEC)	73.6
Gas density..............(LB/ACF)	.05553
Molecular weight......(LB/LBMOLE)	29.11
Mass flow of gas..........(LB/HR)	184907
Volumetric flow rate.............	
actual...................(ACFM)	55493
dry standard............(DSCFM)	37006

Test No. 3
Thermal Oil Heater Stack

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

Date of Determination............	06-28-94
Time of Determination.......(HRS)	1340
Barometric pressure.......(IN.HG)	28.72
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)	-.2
Avg. gas temp.............(DEG-F)	290
Moisture content..........(% V/V)	5.88
Avg. linear velocity.....(FT/SEC)	52.6
Gas density..............(LB/ACF)	.04999
Molecular weight......(LB/LBMOLE)	29.16
Mass flow of gas..........(LB/HR)	86841
Volumetric flow rate.............	
actual...................(ACFM)	28954
dry standard............(DSCFM)	18406

Test No. 7
Press Vent Stack

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

Date of Determination............	06-29-94
Time of Determination.......(HRS)	851
Barometric pressure.......(IN.HG)	29.62
Pitot tube coefficient...........	.84
Number of sampling ports.........	2
Total number of points...........	24
Shape of duct....................	Round
Stack diameter...............(IN)	59.5
Duct area.................(SQ.FT)	19.31
Direction of flow................	UP
Static pressure...........(IN.WC)	-.63
Avg. gas temp.............(DEG-F)	96
Moisture content..........(% V/V)	4.03
Avg. linear velocity.....(FT/SEC)	73.7
Gas density..............(LB/ACF)	.06924
Molecular weight......(LB/LBMOLE)	28.84
Mass flow of gas..........(LB/HR)	354650
Volumetric flow rate.............	
actual...................(ACFM)	85370
dry standard............(DSCFM)	76907

Test No. 8
Press Vent Stack

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

Date of Determination............	06-29-94
Time of Determination.......(HRS)	851
Barometric pressure.......(IN.HG)	28.62
Pitot tube coefficient...........	.84
Number of sampling ports.........	2
Total number of points...........	24
Shape of duct....................	Round
Stack diameter...............(IN)	59.5
Duct area.................(SQ.FT)	19.31
Direction of flow................	UP
Static pressure...........(IN.WC)	-.63
Avg. gas temp.............(DEG-F)	96
Moisture content..........(% V/V)	3.55
Avg. linear velocity.....(FT/SEC)	74.9
Gas density..............(LB/ACF)	.06702
Molecular weight......(LB/LBMOLE)	28.84
Mass flow of gas..........(LB/HR)	348962
Volumetric flow rate.............	
actual..................(ACFM)	86782
dry standard............(DSCFM)	75913

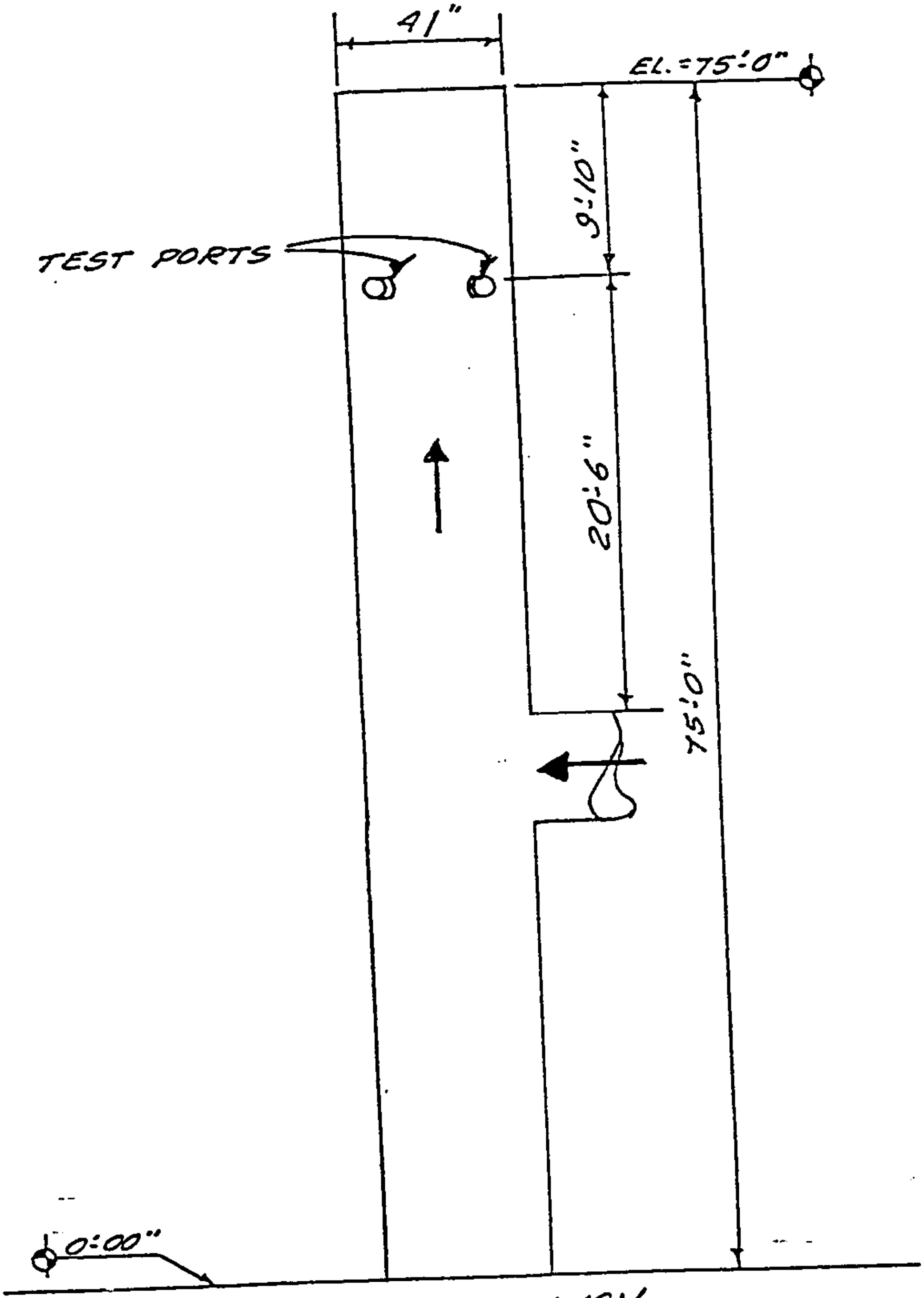
Test No. 10
Dryer Stack

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

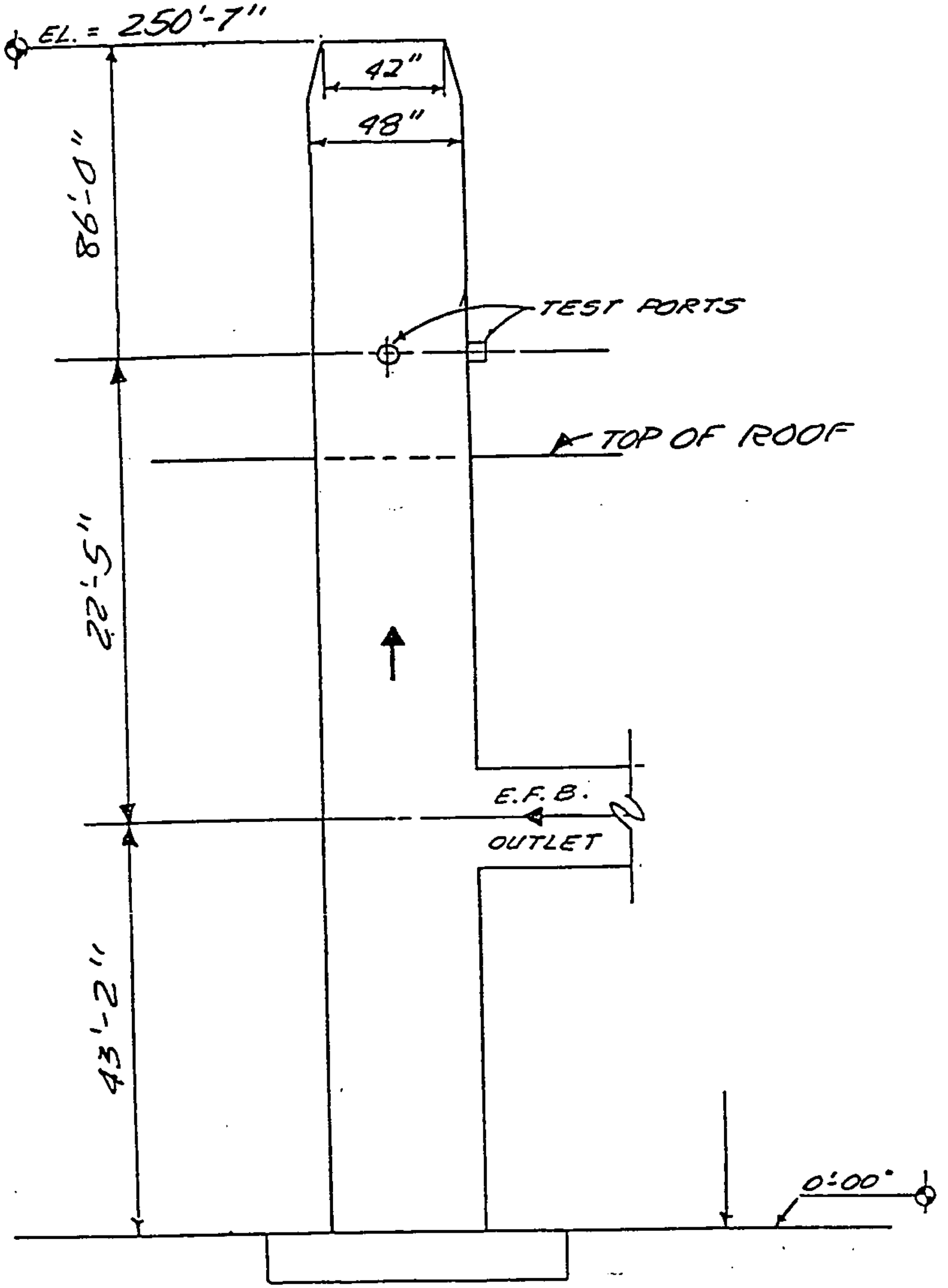
Date of Determination............	06-29-94
Time of Determination.......(HRS)	1800
Barometric pressure.......(IN.HG)	28.62
Pitot tube coefficient...........	.84
Number of sampling ports.........	2
Total number of points...........	24
Shape of duct....................	Round
Stack diameter...............(IN)	41
Duct area.................(SQ.FT)	9.17
Direction of flow................	UP
Static pressure...........(IN.WC)	.53
Avg. gas temp.............(DEG-F)	195
Moisture content..........(% V/V)	26.27
Avg. linear velocity.....(FT/SEC)	69.0
Gas density...............(LB/ACF)	.05261
Molecular weight......(LB/LBMOLE)	29.17
Mass flow of gas..........(LB/HR)	119840
Volumetric flow rate.............	
actual....................(ACFM)	37965
dry standard.............(DSCFM)	21614

APPENDIX B

LOCATION OF TEST PORTS

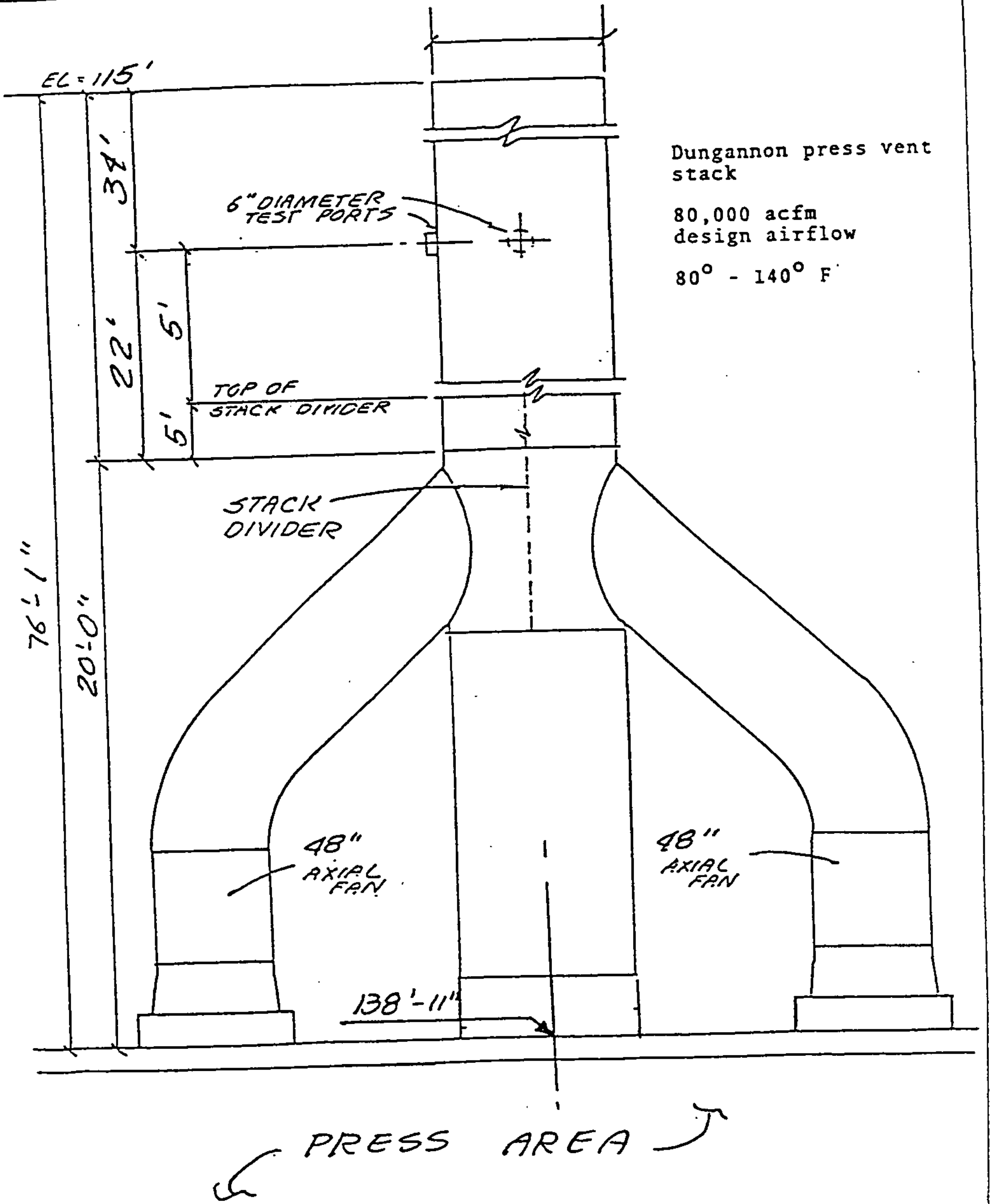


DUNGANNON
THERMAL OIL HEATER STACK
32,600 ACFM
250° - 350° f



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

N.T.S.



Dungannon press vent stack

80,000 acfm design airflow

80° - 140° F

8-14-92

APPENDIX C

THERMAL OIL HEATER FIELD DATA SHEETS

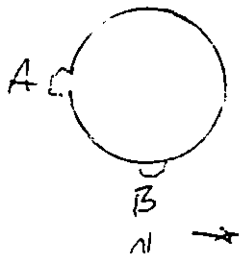
INTERPOLL LABORATORIES, INC.
(612) 786-6020

EPA Method 2 Field Data Sheet

ob LP/DUNGANNON
ource THERMAL OIL HEATER - STACK
Test 1 Run 1 Date 6-29-94
tack Dimen. 41 IN.
ry Bulb ____ °F Wet bulb ____ °F
Manometer ☒ Reg. ☐ Exp ☐ Elec.
arometric Pressure 28.72 IN.HG
tatic Pressure -.20 IN.WC
Operators E. TROWBRIDGE - K. ROSENTHAL
itot No. 23V-5 C_p .84

Drawing of Test Site

Cross-section View



Elevation View

Traverse Point No.		Fraction of Diameter	Distance From Stack Wall (IN.)	Distance From End of Port (IN.)	Velocity	Temp. of Gas (°F)
			Port Length: 8 IN.		Time Start: 0800 HRS	
A	1	.032	1.31	9.31	.60	282
	2	.105	4.31	12.31	.62	
	3	.194	7.95	15.95	.64	
	4	.323	13.24	21.24	.62	282
	5	.677	27.76	35.76	.65	
	6	.806	33.05	41.05	.67	
	7	.895	36.70	44.70	.65	
	8	.968	39.69	47.69	.56	
B	1				.50	
	2				.55	
	3				.58	282
	4				.60	
	5				.62	
	6				.64	
	7				.62	
	8				.60	

Temp. Meas. Device & S/N: PDT-34
Time End: 0812 HRS

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

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job LP/Dungannon
Source Thermal Oil Heater Stack
Method 5 Filter holder: 4" Glass
Date 6-28-94 Test 1 Run 1
No. of traverse points 16
Filter type: 4" Glass Fiber

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Post test: 0 cfm at √ in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used:
4725

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		100	
Impinger No. 2	235	130	35
Impinger No. 3		0	
Condenser			
Desiccant	1400	1384	16
Total	▨	▨	51

Integrated Gas Sampling Data:

Bag Pump No. 23A
Bag Material: 5-layer Aluminized Tedlar
Pretest leak check: 0 cc/min at 15 in. Hg.
Time start: 0531 (HRS)
Sampling rate: 400 cc/min
Box No. 4 Bag No. 1
Size: 44 L
Time end: 0634 (HRS)
Operator: ET

S/N of O_2 Analyzer used to monitor train outlet: 4

123093-G:\STACK\WP\METHODS\S-0046RR

INTERPOLL LABORATORIES M5 METHOD 5 FIELD DATA SHEET

Job CP/Dunkenhein
Source Thermal Air Heater Stack
Date 6-28-84 Test 1 Run 1

Operators E. Thau / B. Kiezer - Kilpsnthal
Meter Box No. 9 ΔH@ 1.78 in HC
Coeff. .9961

Pilot No. 23V-5' Cp .84 H2O ___ %
Bar. Press. 28.72 in Hg
Nozzle No. 6-4 Nozzle Dia. .256 in.

Traverse Point No.		Sampling Time (min)	Sample Volume (cf)	Velocity Head (in HC)	Orifice Meter (in HC)	Dev. Vol. (cf)	VAC. in Hg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
		08:30	130.30											
A	8	4	133.25	.59	1.53	3.16	3.5	285	260	248	48	69	67	
	7	8	136.20	.60	1.53	4.01	4.0	285				71	68	
	6	12	138.98	.61	1.56	8.89	4.0	288	262	250	48	74	69	
	5	16	141.82	.60	1.54	1.76	4.0	284				75	69	
	4	20	144.80	.65	1.67	4.74	4.0	287	267	255	49	77	70	
	3	24	147.78	.65	1.67	7.73	4.0	287				78	71	
	2	28	150.80	.64	1.65	0.71	4.0	286	262	251	49	80	72	
	1	32	153.60	.59	1.53	3.58	3.7	286				81	72	
B	8	36	156.49	.61	1.58	6.49	4.0	285	259	247	51	82	74	
	7	40	159.50	.64	1.67	9.49	4	285				83	74	
	6	44	162.53	.64	1.66	2.49	4	287	264	249	49	84	76	
	5	48	165.52	.62	1.62	5.45	4	286				85	76	
	4	52	168.40	.60	1.57	8.35	4	286	262	247	50	85	76	
	3	56	171.30	.57	1.49	1.20	3.8	284				86	77	
	2	60	174.08	.56	1.47	4.02	3.5	286	264	251	50	86	77	
	1	64	176.75	.50	1.31	6.69	3	285				87	79	
		(0935)												
		θ = 64	Vm = 46.45		ΔH = 1.57							Avg. = 75.5		

C-3

S-00378

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job LP/DUNGANNON
Date 6-25-94 Test 1 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) ☒
Post test: 0 cfm at 5 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used:
6726

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		100	
Impinger No. 2	238	100	38
Impinger No. 3		0	
Condenser			
Desiccant	1480	1459	21
Total	▨	▨	59

Integrated Gas Sampling Data:

Bag Pump No. 234
Box No. 4 Bag No. 2
Bag Material: 5-layer Aluminized Tedlar
Size: 44 L
Pretest leak check: 0 cc/min at 15 in. Hg.
Time start: 1006 (HRS) Time end: 1111 (HRS)
Sampling rate: 400 cc/min Operator: ET

S/N of O_2 Analyzer used to monitor train outlet: 4

INTERPOLL LABORATORIES [illegible]

Job LP Dunnigan
Source Thermal Oil Heater - STACK
Date 6-28-94 Test 1 Run 2

Operators C.-K.R.
Meter Box No. 9 ΔH@ 1.28 in WC
Counter Init. 1961

Pitot No. 23V-5 Cp .8 % H2O
Bar. Press. 28.72 in Hg
Nozzle No. 6-4 Nozzle Dia .250 in.

Traverse Point No.		Sampling Time (min)	Sample Volume (cf)	Velocity Head (in WC)	Orifice Meter (in WC)	Dry Vol. (cf)	VAC. in Hg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
		1005	177.00											
B	8	4	179.99	.62	1.64	9.86	4	285	254	247	48	81	77	
	7	8	183.10	.66	1.75	3.04	4	286				84	79	
	6	12	186.20	.66	1.76	6.12	4	286	260	258	45	86	80	
	5	16	189.25	.64	1.71	9.17	4	287				88	81	
	4	20	192.18	.58	1.55	2.08	3.8	287	247	259	50	90	83	
	3	24	194.98	.55	1.48	4.93	3.5	287				92	85	
	2	28	197.82	.53	1.43	7.73	3.5	288	265	260	50	93	86	
	1	32	200.45	.48	1.29	0.40	3.0	258				95	87	
A	8	36	203.20	.53	1.43	3.21	3.5	287	261	258	52	96	88	
	7	40	206.06	.55	1.49	6.08	3.5	289				97	89	
	6	44	208.94	.55	1.49	8.86	3.5	289	260	259	52	98	90	
	5	48	211.87	.56	1.52	1.86	3.6	289				99	91	
	4	52	214.90	.60	1.63	4.88	4	289	262	260	52	100	92	
	3	56	217.99	.63	1.71	7.97	4	289				101	93	
	2	60	221.04	.60	1.63	0.99	4	290	263	253	56	102	94	
	1	64	223.75	.48	1.51	3.70	3	280				103	95	
		(1112)												
		θ = 64	Vm = 46.75		ΔH = 1.55							Avg. = 984		

S-0037R

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job LP/Dungannon
Date 6-28-94 Test 1 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) ☐
Post test: 0 cfm at ✓ in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used:
6728

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		100	
Impinger No. 2	240	100	40
Impinger No. 3		0	
Condenser			
Desiccant	1409	1400	9
Total			49

Integrated Gas Sampling Data:

Bag Pump No. 23A
Box No. 4 Bag No. 3
Bag Material: 5-layer Aluminized Tedlar
Size: 44 L
Pretest leak check: 0
cc/min at 15 in. Hg.
Time start: 1138
(HRS) Time end: 1242 (HRS)
Sampling rate: 400
cc/min Operator: ET

S/N of O_2 Analyzer used to monitor train outlet: 4

INTERPOLL LABORATORIES - [illegible] METHOD 5 FIELD DATA SHEET

Job LP Binghamton
Source Thermal oil Heater Stack
Date 6-23-94 Test 1 Run 3

Operators ET-KR
Meter Box No. 9 ΔH@ 1.75 IN WC
Counter coeff. .9961

Pitot No. 731-5 Cp .84
Bar. Press. 28.72 InHg H2O %
Nozzle No. 2-21 Nozzle Dia .250 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Del. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	1137	224.00											
A 8	4	226.78	.52	1.40	4.78	3.0	290	252	260	49	94	94	
7	8	229.60	.52	1.41	9.58	3.0	289				99	95	
6	12	232.45	.53	1.45	2.42	3.0	289	255	257	50	100	95	
5	16	235.25	.54	1.48	5.30	3.1	288				101	96	
4	20	238.28	.60	1.64	8.33	3.8	289	254	263	52	102	97	
3	24	241.32	.61	1.67	1.39	3.8	289				103	97	
2	28	244.30	.58	1.59	4.38	3.7	287	256	260	55	103	97	
1	32	247.06	.48	1.32	7.11	3.0	287				103	98	
B 8	36	250.14	.59	1.62	0.15	4.0	287	253	261	54	103	98	
7	40	253.26	.62	1.70	3.22	4.0	288				105	99	
6	44	256.37	.63	1.73	6.34	4.0	290	251	260	56	106	99	
5	48	259.40	.60	1.65	9.39	4.0	290				106	99	
4	52	262.30	.56	1.54	2.34	3.8	290	249	260	54	107	100	
3	56	265.15	.50	1.38	5.15	3.7	290				107	101	
2	60	267.92	.48	1.32	7.87	3.0	290	250	256	55	108	101	
1	64	270.56	.45	1.24	0.55	3.0	290				108	102	
	(1249)												
	θ = 64	Vm = 46.56		ΔH = 1.51							Avg. = 100.7		

INTERPOLL LABORATORIES, INC.
(612) 786-6020

EPA Method 2 Field Data Sheet

Job LP/Davenport
Source Thermal Oil Heater Stack
Test 3 Run 2 Date 6-28-94
Stack Dimen. 41 IN.
Dry Bulb ____ °F Wet bulb ____ °F
Manometer ☒ Reg. ☐ Exp ☐ Elec.
Barometric Pressure 28.72 IN.HG
Static Pressure -.20 IN.WC
Operators E [illegible] - K. [illegible]
Pitot No. PM10-1 Cp .840
PM-10

Drawing of Test Site

Cross-section View	Elevation View

Traverse Point No.	Fraction of Diameter	Distance From Stack Wall (IN.)	Distance From End of Port (IN.)	Velocity	Temp. of Gas (°F)
▨		Port Length:	8 IN.	Time Start: 1340	HRS
A 1	.044	1.80	9.80	.46	
2	.146	5.99	13.99	.53	
3	.296	12.14	20.14	.57	
4	.704	28.86	36.86	.64	290
5	.854	35.01	43.01	.65	
6	.956	39.20	47.20	.63	
B 1				.62	
2				.65	
3				.64	
4				.58	290
5				.56	
6				.52	
Temp. Meas. Device & S/N:	PDT-34			Time End: 1348	HRS

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

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job CP/DUNGANNON Date 4-28-94 Test 3 Run 1
Source THERMAL OIL HEATER-STACK No. of traverse points 12
Method PM(10) Filter holder: ELC Filter type: 2 1/2 GLASS FIBER

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Post test: 0 cfm at 5 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used: 6211

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		100	
Impinger No. 2	233	100	33
Impinger No. 3		0	
Condenser			
Desiccant	1489	1480	9
Total	▨	▨	42

Integrated Gas Sampling Data:

Bag Pump No. 24A Box No. 21 Bag No. 1
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: 0 cc/min at 15 in. Hg.
Time start: 1356 (HRS) Time end: 1511 (HRS)
Sampling rate: 300 cc/min Operator: ET

S/N of O_2 Analyzer used to monitor train outlet:

123093-G:\STACK\WP\METHODS\S-0046RR

LI-011

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job CP/Dualgannon
Source Thermal Oil Heater Stack
Date 6-28-94 Test 3 Run 1

Operators ET/KR
Meter Box No. 9 ΔH@ 1.75 in WC
Counter coeff. .9961

Pitot No. P410-1 Cp .84
Bar. Press. 28.[illegible] in Hg H2O ___ %
Nozzle No. [illegible] Nozzle Dia .215 in.

Traverse Point No.	Sampling Time (min)	Sample* Volume (cf)	Velocity Head (in WC)	Orifice Meter (in WC)	Dgs. Vol. (cf)	VAC. in Hg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	1355	270.90											
A 6	6.61	274.00	.62	.59	6.61	2	290	244	241	44	99	99	
5	13.28	277.10	.64	.59	6.66	2	287	246	250	45	103	100	
4	19.73	280.05	.60	.59	6.45	2	286	257	245	47	105	101	
3	25.91	283.00	.55	.59	6.18	2	287	257	244	53	107	102	
2	31.98	285.77	.53	.60	6.06	2	287	261	245	50	108	103	
1	37.75	288.52	.48	.59	5.77	2	287	257	242	51	108	103	
B 6	43.65	291.45	.50	.59	5.89	2	287	258	240	50	108	103	
5	49.71	294.08	.53	.60	6.06	2	257	255	242	51	108	105	
4	55.95	297.02	.56	.60	6.23	2	289	254	243	47	108	103	
3	62.40	300.00	.60	.60	6.45	2	289	252	244	49	108	103	
2	68.97	303.20	.62	.60	6.56	2	290	250	242	50	107	102	
1	75.53	306.30	.62	.60	6.56	2	290	251	240	50	108	103	
	(1512)												
	θ = 75.53	Vm = 35.40		ΔH = .59							Avg. = 104.2		

C-10

S-0037R

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job LP/[illegible]
Date 6-28-94 Test 3 Run 2
Source Thermal Oil Heater stack
No. of traverse points 12
Method PM 10 Filter holder: EHC
Filter type: 2½ Glass Fiber

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Post test: 0 cfm at 5 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used: 6214

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		100	
Impinger No. 2	227	100	27
Impinger No. 3		0	
Condenser			
Desiccant	1418	1400	18
Total	▨	▨	45

Integrated Gas Sampling Data:

Bag Pump No. 244
Box No. 21 Bag No. 2
Bag Material: 5-layer Aluminized Tedlar
Size: 44 L
Pretest leak check: 0 cc/min at 15 in. Hg.
Time start: 1531 (HRS) Time end: 1645 (HRS)
Sampling rate: 400 cc/min Operator: ET

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

123093-G:\STACK\WP\METHODS\S-0046RR

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job LP/Longgrood
Source Thermal Oil Heater Stack
Date 6-29-94 Test 3 Run 2

Operators ET-KK
Meter Box No. 9 ΔH@ 1.79 IN WC
Counter coeff. .9961

Pitot No. 25V-5 Cp .84
Bar. Press. 26.72 in Hg H2O ___ %
Nozzle No. Glass Nozzle Dia .210 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (in WC)	Orifice Meter (in WC)	Dev. Vol. (cf)	VAC. in Hg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	1530	306.50											
A 6	4.41	309.55	.60	.59	6.41	2	287	249	242	45	103	102	
5	12.47	312.60	.63	.59	6.57	2	289	251	245	48	105	102	
4	19.40	315.50	.60	.60	6.41	2	289	253	248	50	107	103	
3	25.55	318.62	.55	.60	6.14	2	289	250	247	50	107	103	
2	31.52	321.48	.52	.60	5.97	2	289	248	250	51	107	103	
1	37.26	324.20	.48	.59	5.73	2	289	245	248	49	107	103	
B 6	43.12	327.00	.50	.59	5.85	2	289	248	251	49	107	103	
5	49.21	329.85	.54	.59	6.08	2	287	253	250	50	106	102	
4	55.41	332.67	.56	.59	6.19	2	286	251	247	50	106	102	
3	61.77	335.75	.59	.59	6.36	2	287	248	249	51	106	102	
2	68.29	338.85	.62	.60	6.52	2	289	245	247	51	107	103	
1	74.87	342.00	.63	.60	6.57	2	289	242	245	52	107	103	
	1646												
	θ = 74.87	Vm = 35.50		ΔH = .59							Avg. = 104.4		

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job 4/DUNGANNON
Source THERMAL OIL HEATER - STACK
Method PM 10 Filter holder: EXC

Date 6-28-94 Test 3 Run 3
No. of traverse points 12
Filter type: 2 1/2" GLASS FIBER

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☑
Post test: 0 cfm at 5 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used:
6213

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		100	
Impinger No. 2	234	100	34
Impinger No. 3		0	
Condenser			
Desiccant	1495	1489	6
Total	▨	▨	40

Integrated Gas Sampling Data:

Bag Pump No. 2/4
Bag Material: 5-layer Aluminized Tedlar
Pretest leak check: 0
Time start:
Sampling rate: 400

Box No. 2-1 Bag No. 3
Size: 44 L
cc/min at 15 in. Hg.
(HRS) Time end: (HRS)
cc/min Operator: ET

S/N of O_2 Analyzer used to monitor train outlet:

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INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job LP/Dungannon
Source Thermal oil heater stack
Date 6-28-79 Test 3 Run 3

Operators ET-KK
Meter Box No. 9 ΔH@ 1.75 IN WC
Gasmeter coeff. .9961

Pitot No. [illegible] Cp .84
Bar. Press. 28.72 inHg H2O ___ %
Nozzle No. [illegible] Nozzle Dia .216 IN.

Traverse Point No.	Sampling Time (min)	Sample* Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Del. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	1703	342.20											
A 6	6.35	345.25	.60	.59	6.35	2	287	251	245	49	97	95	
5	12.82	348.38	.62	.59	6.46	2	287	254	244	49	100	98	
4	19.23	351.27	.61	.59	6.41	2	287	257	245	50	101	98	
3	25.26	354.11	.54	.59	6.03	2	288	254	246	50	102	98	
2	31.18	356.87	.52	.59	5.91	2	287	252	247	51	102	98	
1	36.87	359.53	.48	.59	5.68	2	285	250	245	50	102	98	
B 6	42.67	362.24	.50	.59	5.80	2	287	253	249	52	102	98	
5	48.65	365.00	.53	.59	5.97	2	285	256	250	52	102	97	
4	54.79	367.90	.56	.59	6.14	2	285	260	249	51	102	97	
3	61.09	370.87	.59	.59	6.30	2	285	258	248	51	102	97	
2	67.56	373.90	.62	.59	6.46	2	285	255	242	50	102	97	
1	73.92	376.90	.60	.59	6.35	2	283	253	240	50	102	97	
	(1818)												
	θ = 73.92	Vm = 34.70		ΔH = .59							Avg. = 99.5		

APPENDIX D

DRYER FIELD DATA SHEETS

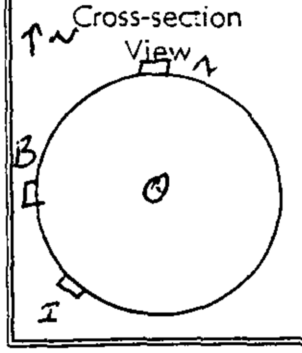
INTERPOLL LABORATORIES, INC.
(612) 786-6020

EPA Method 2 Field Data Sheet

ob L.P. / Dungannon, VA
ource Dryer / Stack
est 2 Run 0 Date 6-28-94
tack Dimen. 48 IN.
ry Bulb 194 °F Wet bulb 130 °F
lanometer ☒ Reg. ☐ Exp ☐ Elec.
arometric Pressure 28.72 IN.HG
tatic Pressure +.72 IN.WC
perators M. Koehler + D. Marsco
itot No. UMS-6 C_p .84

Drawing of Test Site

Cross-section View | Elevation View



Traverse Point No.	Fraction of Diameter	Distance From Stack Wall (IN.)	Distance From End of Port (IN.)	Velocity	Temp. of Gas (°F)
▨		Port Length: 6.0 IN.		Time Start: 0831 HRS	
A-1	.021	1.01	7.01	.94	
2	.067	3.22	9.22	1.00	
3	.118	5.66	11.66	1.07	
4	.177	8.50	14.50	1.13	
5	.250	12.00 ~~12.09~~	18.00	1.25	
6	.356	17.09 ~~30.91~~	23.09	1.33	
7	.644	30.91 ~~36.00~~	36.96	[illegible]	
8	.750	36.00 ~~39.50~~	42.00	1.49	
9	.823	39.50 ~~41.34~~	45.50	1.47	
10	.882	42.34 ~~44.78~~	48.34	1.32	
11	.933	44.78	50.78	1.37	
12	.979	46.99	52.99	1.29	194
B-1				1.09	
2				1.19	
3				1.19	
4				1.24	
5				1.35	
6				1.40	
7				1.44	
8				1.42	
9				1.37	
10				1.39	
11				1.35	
12				1.20	
Temp. Meas. Device & S/N:		PDT-31 / TC		Time End: 0938 HRS	

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

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job L.P. / Dungannon, VA
Date 6-25-'94 Test 2 Run 1
Source Dryer / Stack
No. of traverse points 24
Method 0011 Filter holder: NA
Filter type: NA

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Post test: <0.02 cfm at 10 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used: NA

Recovery solvent(s)
☐ acetone
☒ other(s) MeCl₂

No. of probe wash bottles: 0
Sample recovered by: M. Kaehler + D. Marsso

Condensate Data:

Item	Weight (g)		
	Final	Tare	[illegible]
Impinger No. 1	640	472	168
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1391	1377	14
Total	▨	▨	182

Integrated Gas Sampling Data:

Bag Pump No. 23B
Box No. 2 Bag No. 1
Bag Material: 5-layer Aluminized Tedlar
Size: 44 L
Pretest leak check: 0 cc/min at 15 in. Hg.
Time start: 0950 (HRS)
Time end: 0951 (HRS)
Sampling rate: 400 cc/min
Operator: M. Kaehler

S/N of O₂ Analyzer used to monitor train outlet: None

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INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job L.P. / Dungannon, VA
Source Dryer / Stack
Date 6-28-94 Test 2 Run 1

Operators M. Kuehler + D. Marzzo
Meter Box No. 5 ΔH@ 1.79 IN WC
Gasmeter coeff. .9997

Pitot No. AAMS-6 Cp .84
Bar. Press. 28.72 inHg H2O 20 X
Nozzle No. Glass-4 Nozzle Dia .339 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Des. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	0950	805.40											
A - 12	2.5	807.65	1.19	2.36	2.59	7	194	269	256	48	67	68	
11	5	809.94	1.32	2.60	9.89	7.5	193				74	68	
10	7.5	812.43	1.49	2.96	2.35	9	193	244	256	49	79	68	
9	10	814.98	1.47	2.93	4.80	9	194				81	68	
8	12.5	817.29	1.49	2.97	2.27	9	195	237	265	50	83	68	
7	15	819.95	1.60	3.19	9.83	9.5	195				86	69	
6	17.5	822.20	1.28	2.57	2.14	8	193	237	261	51	88	69	
5	20	824.47	1.31	2.61	4.48	8	193				90	70	
4	22.5	826.72	1.13	2.28	6.66	7	194	241	269	50	91	72	
3	25	828.75	1.03	2.08	8.74	7	194				91	72	
2	27.5	830.80	.91	1.84	0.71	6	195	243	264	50	93	73	
1	30	832.74	.97	1.77	2.63	5.5	194				94	73	
B - 12	32.5	834.97	1.14	2.31	4.83	7	194	240	261	51	92	74	
11	35	837.23	1.31	2.66	7.19	7.5	192				96	75	
10	37.5	839.72	1.40	2.85	9.64	8	193	247	252	49	96	75	
9	40	842.10	1.43	2.91	2.11	8.5	194				97	76	
8	42.5	844.56	1.48	3.02	4.63	9	194	255	254	51	98	76	
7	45	847.00	[illegible]	2.96	[illegible]	9	194				98	77	
6	47.5	849.51	[illegible]	2.90	[illegible]	9.5	195	256	265	52	98	77	
5	50	851.93	[illegible]	[illegible]	[illegible]	9.5	195				98	78	
4	52.5	854.35	[illegible]	[illegible]	[illegible]	8	195	257	246	52	99	78	
3	55	856.52	1.19	2.40	[illegible]	8	194				99	79	
2	57.5	858.87	1.15	2.33	[illegible]	7.5	194	252	249	53	99	79	
1	60	860.97	1.05	2.15	[illegible]	7	194				100	79	
	0951												
	θ = 60	Vm = 55.57		2.59							Avg. = 82.2		

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job L.P. / Dungannon, VA
Source Dryer / Stack
Method 0011 Filter holder: NA
Date 6-28-98 Test 2 Run 2
No. of traverse points 24
Filter type: NA

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Post test: <0.02 cfm at 12 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used:
NA

Recovery solvent(s)
☐ acetone
☒ other(s) MeCl2

No. of probe wash bottles: 0
Sample recovered by: M. Koehler + D. Musso

Condensate Data:

Item	Weight (g)		
	Final	Tare	[illegible]
Impinger No. 1	657	471	186
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1409	1391	18
Total	▨	▨	204

Integrated Gas Sampling Data:

Bag Pump No. 23 B
Bag Material: 5-layer Aluminized Tedlar
Pretest leak check: 0 cc/min at 15 in. Hg.
Time start: 1025 (HRS)
Sampling rate: 400 cc/min
Box No. 7 Bag No. 3
Size: 44 L
Time end: 1127 (HRS)
Operator: M. Koehler

S/N of O_2 Analyzer used to monitor train outlet: None

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INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job L.P. / Dungannon, VA
Source Dryer 1 Stack
Date 6-28-94 Test 2 Run 2

Operators M. Kuehler & D. Marsco
Meter Box No. 5 ΔH@ 1.79 IN WC
Gasmeter coeff. .9997

Pitot No. UM5-6 Cp .84
Bar. Press. 28.72 inHg H2O 14.1 x
Nozzle No. 6ss-4 Nozzle Dia .239 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dgm Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	1025	861.40											
B-12	2.5	863.65	1.12	2.50	3.68	7	195	239	248	50	78	78	
11	5	866.15	1.31	2.88	6.12	8.5	199				97	77	
10	7.5	868.69	1.40	3.09	8.66	9	201	251	252	55	91	77	
9	10	871.23	1.38	3.04	1.19	9	204				94	78	
8	12.5	873.79	1.41	3.13	3.74	9.5	202	253	264	54	97	79	
7	15	876.33	1.45	3.22	6.35	10	203				100	80	
6	17.5	878.89	1.30	2.90	8.92	9	204	255	260	52	100	80	
5	20	881.31	1.32	2.95	1.32	9	202				102	80	
4	22.5	883.75	1.13	2.53	3.64	8	203	249	252	51	103	83	
3	25	885.93	1.02	2.29	5.95	7	202				103	84	
2	27.5	887.42	.80	1.80	7.91	6	202	255	258	51	104	84	
1	30	889.79	.78	1.76	9.25	6	203				106	85	
A-12	32.5	892.22	1.18	2.66	2.14	8	202	252	261	50	104	85	
11	35	894.65	1.37	3.09	4.71	9.5	202				107	96	
10	37.5	897.34	1.52	3.41	7.41	10.5	206	246	261	50	107	87	
9	40	900.03	1.47	3.31	0.07	10.5	205				107	87	
8	42.5	902.62	1.39	3.13	2.66	10	204	250	260	52	107	87	
7	45	905.26	1.43	3.22	5.29	10	205				107	88	
6	47.5	907.80	1.30	2.92	7.79	9.5	207	247	263	51	108	89	
5	50	910.00	1.07	[illegible]	0.07	7.5	206				109	89	
4	52.5	912.37	1.08	2.32	[illegible]	7.5	206	245	261	51	109	89	
3	55	914.45	.98	2.10	[illegible]	7	205				109	90	
2	57.5	916.48	.98	1.98	[illegible]	6	205	248	257	51	110	90	
1	60	918.48	.29	1.70	8.37	5.0	203				111	90	
	(1127)												
	θ = 60	Vm = 57.08		ΔH 2.68							Avg. = 93.3		

w=17

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job L.P. / Dungannon, VA
Source Dryer / Stack
Method 0011 Filter holder: NA
Date 6 15 94 Test 2 Run 3
No. of traverse points 24
Filter type: NA

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Post test: ≤0.02 cfm at 12 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used: NA

Recovery solvent(s)
☐ acetone
☒ other(s) MeCl,

No. of probe wash bottles: 0
Sample recovered by: M. Kachler + D. Marsso

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	630	473	[illegible]
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1537	1520	17
Total	▨	▨	174

Integrated Gas Sampling Data:

Bag Pump No. 23B
Box No. 7 Bag No. 3
Bag Material: 5-layer Aluminized Tedlar
Size: 44 L
Pretest leak check: 0 cc/min at 15 in. Hg.
Time start: 1200 (HRS) Time end: (HRS)
Sampling rate: 400 cc/min Operator: M. Kachler

S/N of O_2 Analyzer used to monitor train outlet: None

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INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job L.P. / Dungannon, VA
Source Dryer / Stack
Date 6-29-94 Test 2 Run 3

Operators M. Kuehler + D. Marzzo
Meter Box No. 5 ΔH@ 1.77 IN WC
Gasmeter coeff. .9997

Pilot No. MS-6 Cp .84
Bar. Press. 28.72 inHg H2O 15.4 %
Nozzle No. 6hs-4 Nozzle Dia .235 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (xx/x)
	1200	918.90											
A-12	2.5	921.26	1.20	2.61	1.15	8	207	236	265	50	90	89	
11	5	923.61	1.19	2.57	3.49	8	207				96	89	
10	7.5	925.99	1.32	2.86	5.96	8.5	208	233	258	51	102	89	
9	10	928.63	1.50	3.26	8.59	10	208				103	90	
8	12.5	931.12	1.33	2.91	1.09	9	207	237	255	51	104	90	
7	15	933.65	1.40	3.06	3.65	9	207				106	90	
6	17.5	935.98	1.12	2.46	5.95	8	207	237	246	52	107	91	
5	20	938.20	1.07	2.36	8.21	8	206				109	91	
4	22.5	940.57	1.20	2.65	0.60	8	206	231	244	49	110	92	
3	25	942.87	1.13	2.50	2.92	7.5	206				110	92	
2	27.5	945.17	1.01	2.24	5.13	7	203	239	251	48	111	93	
1	30	947.20	.92	1.82	7.12	6	204				112	93	
B-12	32.5	949.39	1.10	2.45	9.42	7.5	204	243	254	48	111	94	
11	35	951.72	1.04	2.32	1.66	7	201				112	95	
10	37.5	954.07	1.25	2.79	4.12	8.5	202	249	257	48	113	95	
9	40	956.65	1.35	3.01	6.68	9	204				113	95	
8	42.5	959.11	1.12	2.49	9.01	8	206	232	249	48	113	96	
7	45	961.60	1.49	3.30	1.68	10	203				114	96	
6	47.5	964.35	1.40	3.13	4.29	10	203	246	243	49	114	97	
5	50	966.81	1.35	3.02	6.85	9.5	203				114	98	
4	52.5	969.40	1.32	2.95	9.39	9.5	203	240	251	49	115	98	
3	55	971.75	1.17	2.62	1.78	8.5	203				115	97	
2	57.5	974.14	1.03	2.31	4.03	7.5	202	237	241	48	116	98	
1	60	976.31	.94	2.11	6.18	7	203				116	99	
	60												
	θ = 1302	Vm = 57.51		ΔH 2.66							Avg. = 101.4		

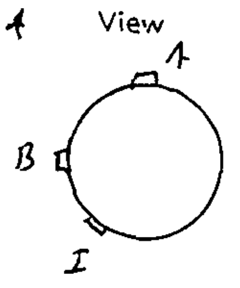
INTERPOLL LABORATORIES, INC.
(612) 786-6020

EPA Method 2 Field Data Sheet

Job L.P./Dungannon, VA
Source Dryer /Stack
Test 6 Run 0 Date 6-28-94
Stack Dimen. 48 IN.
Dry Bulb 205 °F Wet bulb 133 °F
Manometer ☒ Reg. ☐ Exp ☐ Elec.
Barometric Pressure 28.72 IN.HG
Static Pressure +.73 IN.WC
Operators M. Koehler + D. Marsso
Pitot No. 23V-6 C_p .84

Drawing of Test Site

Cross-section View



Elevation View

Traverse Point No.	Fraction of Diameter	Distance From Stack Wall (IN.)	Distance From End of Port (IN.)	Velocity	Temp. of Gas (°F)
		Port Length: 6 IN.		Time Start: HRS	
		Refer to	Test No 2		
		for pts	and flows		
Temp. Meas. Device & S/N:		PDT-31 / TC		Time End: HRS	

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

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INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job L.P. / Dungannon, VA
Date 6-28-94 Test 6 Run 1
Source Dryer 1 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) ☑
Post test: < 0.02 cfm at 8 in. Hg. (vac) ☑

Particulate Catch Data:

No. of filters used: 6724

Recovery solvent(s)
☑ acetone
☑ other(s) $MeCl_2$

No. of probe wash bottles:
Sample recovered by:

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	629	494	135
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1418	1409	9
Total	▨	▨	144

Integrated Gas Sampling Data:

Bag Pump No. 23B
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: 1426 (HRS)
Time end: 1529 (HRS)
Sampling rate: 400 cc/min
Operator: M. Kaehler

S/N of O_2 Analyzer used to monitor train outlet: None

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INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job L.P. / Duyannon, VA.
Source Dryer / Stack
Date 6-28-94 Test 6 Run 1

Operators M. Koehler + D. Marsac
Meter Box No. 5 ΔH@ 1.79 IN WC
Counter coeff. .9997

Pitot No. MMS-6 Cp .84
Bar. Press. 28.72 in Hg H2O [illegible] %
Nozzle No. 2-3 Nozzle Dia .185 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (in WC)	Orifice Meter (in WC)	Dry. Vol. (cf)	VAC. in Hg	Temperatures (°F) Stack	Probe	Oven	Imp.	Gas/In	Gas/Out	Oxygen (%v/v)
	1426	976.70											
B-12	2.5	978.07	1.04	.84	8.03	4	205	229	256	55	92	92	
11	5	979.51	1.22	.98	9.49	4	204				95	92	
10	7.5	981.00	1.34	1.08	1.01	4.5	206	235	252	53	99	93	
9	10	982.62	1.32	1.06	2.52	4.5	208				101	93	
8	12.5	984.07	1.31	1.06	4.03	4.5	208	241	250	52	103	94	
7	15	985.57	1.27	.99	5.50	4	206				105	94	
6	17.5	986.94	1.03	.84	6.85	4	207	235	257	56	106	94	
5	20	988.30	1.13	.92	8.26	4	206				107	94	
4	22.5	989.70	1.09	.88	9.65	4	206	234	256	54	108	94	
3	25	991.07	1.05	.86	1.01	4	205				109	95	
2	27.5	992.42	.97	.79	2.33	4	205	232	255	56	109	96	
1	30	993.65	.82	.67	3.54	4	206				109	96	
A-12	32.5	994.98	1.06	.87	4.92	4	205	240	252	56	107	97	
11	35	996.47	1.22	.99	6.39	4.5	208				111	97	
10	37.5	997.96	1.34	1.10	7.94	5	205	247	259	57	112	98	
9	40	999.52	1.38	1.14	9.52	5	205				111	98	
8	42.5	1001.10	1.40	1.15	1.11	5	208	242	257	57	112	98	
7	45	1002.57	1.31	1.08	2.64	5	207				113	98	
6	47.5	1004.12	1.07	.88	4.03	4.5	206	251	262	57	113	98	
5	50	1005.41	.93	.77	5.33	4	205				113	99	
4	52.5	1006.76	.91	.75	6.61	4	206	247	255	52	113	99	
3	55	1007.95	.84	.69	7.85	4	205				113	99	
2	57.5	1009.18	.75	.62	9.01	4	205	244	253	58	113	99	
1	60	1010.41	.72	.59	0.16	4	206				113	100	
	1529												
	θ = 60	Vm = 33.71		ΔH = .90							Avg. = 101.9		

S-0037R

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job L.P./Dungannon, VA
Source Dryer/Stack
Method 5 Filter holder: Glass
Date 6-28-94 Test 6 Run 2
No. of traverse points 24
Filter type: 4" G.F.

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Post test: <0.02 cfm at 8 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used:
6716

Recovery solvent(s)
☒acetone
☒other(s) MeCl,

No. of probe wash bottles: 1
Sample recovered by: M. Koehler + D. Musso

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	620	496	124
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1546	1537	9
Total	▨	▨	133

Integrated Gas Sampling Data:

Bag Pump No. 23B
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: 1641 (HRS) Time end: 1742 (HRS)
Sampling rate: 400 cc/min Operator: M. Koehler

S/N of O_2 Analyzer used to monitor train outlet: None

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INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job L.P. / Dinguannag, VA
Source Dryer / Stack
Date 6-28-94 Test 6 Run 2

Operators M. Kaehler / D. Merz
Meter Box No. 5 ΔH@ 1.79 in HC
Gasmeter coeff.: .9992

Pitot No. 22V-6 Cp .84
Bar. Press. 29.72 in Hg H2O 18.2 %
Nozzle No. 2-3 Nozzle Dia .185 in.

Traverse Point No.	Sampling Time (min)	Sample* Volume (cf)	Velocity Head (in H2O)	Orifice Meter (in H2O)	Dry. Vol. (cf)	VAC. in Hg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	1641	10.20											
A-12	2.5	12.12	1.08	.81	12.03	3.5	206	249	257	54	97	97	
11	5	13.50	1.29	.95	3.46	4	206				98	961	
10	7.5	14.98	1.38	1.03	4.95	4	206	253	250	54	101	96	
9	10	16.51	1.42	1.06	6.47	4	205				103	96	
8	12.5	18.08	1.47	1.10	8.02	4.5	206	250	255	54	105	96	
7	15	19.57	1.43	1.07	9.55	4	206				107	96	
6	17.5	20.93	1.20	.90	0.95	4	206	250	258	52	107	96	
5	20	22.28	1.13	.85	2.31	4	204				108	97	
4	22.5	23.60	1.05	.79	3.63	3.5	203	241	259	51	108	96	
3	25	24.92	1.08	.81	4.96	4	204				109	96	
2	27.5	26.31	1.02	.77	6.26	3.5	205	237	254	52	109	96	
1	30	27.55	.94	.71	2.50	3.5	206				110	97	
B-12	32.5	28.90	1.10	.83	8.85	4	206	240	257	52	108	97	
11	35	30.30	1.17	.91	0.26	4	201				110	97	
10	37.5	31.82	1.35	1.05	1.78	4.5	201	245	250	52	111	97	
9	40	33.37	1.41	1.10	3.33	4.5	199				112	97	
8	42.5	34.98	1.48	1.16	4.92	5	199	243	260	53	112	97	
7	45	36.57	1.35	1.06	6.44	5	200				112	97	
6	47.5	38.07	1.27	.99	2.92	4.5	199	238	264	53	112	98	
5	50	39.48	1.31	1.03	9.42	4.5	199				112	97	
4	52.5	40.94	1.17	.91	0.83	4	203	241	271	52	113	98	
3	55	42.24	1.09	.85	2.20	4	202				112	98	
2	57.5	43.58	1.01	.79	3.51	4	201	242	268	50	112	98	
1	60	44.85	.92	.72	4.77	4	200				112	98	
	1742												
	Θ = 60	Vm = 34.15		ΔH .93							Avg. = 102.5		

S-0037R

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job L.P. / Dungannon, VA
Date 6-28-94 Test 6 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) ☒
Post test: <0.02 cfm at 7 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used: 6717

Recovery solvent(s)
☒ acetone
☒ other(s) $MeCl_2$

No. of probe wash bottles: 1
Sample recovered by: M. Kachler + D. Marsco

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	648	500	148
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1426	1418	8
Total	▨	▨	156

Integrated Gas Sampling Data:

Bag Pump No. 23 B
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: 1813 (HRS) Time end: 1915 (HRS)
Sampling rate: 400 cc/min Operator: M. Kachler

S/N of O_2 Analyzer used to monitor train outlet: None

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INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job L.P. / Dinzanger, VA
Source Dryer / Stack
Date 6-28-94 Test 6 Run 3

Operators M. Kuehler + D. Marzo
Meter Box No. 5 ΔH@ 1.29 in WC
Correction coeff. .9997

Pitot No. 23V-6 Cp .84
Bar. Press. 28.73 inHg H2O 16.9 %
Nozzle No. 2-3 Nozzle Dia .195 in.

Traverse Point No.	Sampling Time (min)	Sample* Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dev. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	18:13	45.20											
B-12	2.5	46.55	1.10	.85	6.56	4	203	237	255	54	95	95	
11	5	47.92	1.07	.82	2.89	4	202				99	95	
10	7.5	49.45	1.38	1.06	9.41	4	204	231	257	54	102	95	
9	10	50.95	1.43	1.10	0.95	4	204				105	95	
8	12.5	52.58	1.51	1.17	2.54	4.5	204	233	257	44	107	96	
7	15	54.15	1.37	1.06	9.06	4	204				109	96	
6	17.5	55.63	1.30	1.01	5.55	4	203	233	256	42	109	96	
5	20	56.99	1.20	.93	6.98	4	203				109	96	
4	22.5	58.41	1.13	.88	8.36	4	203	232	252	43	110	96	
3	25	59.85	1.07	.83	9.71	4	203				111	97	
2	27.5	60.94	.93	.73	0.97	3.5	201	235	261	43	110	97	
1	30	62.30	.87	.68	2.19	3.5	202				111	97	
A-12	32.5	63.58	1.05	.82	3.53	3.5	202	234	257	43	108	97	
11	35	65.14	1.27	.99	5.00	4	202				110	97	
10	37.5	66.55	1.23	.96	6.44	4	202	240	255	45	111	97	
9	40	68.03	1.31	1.02	2.94	4	202				112	97	
8	42.5	69.55	1.35	1.05	9.46	4	203	243	258	45	112	97	
7	45	71.00	1.42	1.11	1.01	4.5	203				112	97	
6	47.5	72.63	1.28	1.00	2.44	4	203	241	261	45	112	97	
5	50	74.07	1.31	1.02	3.99	4	204				113	97	
4	52.5	75.48	1.07	.83	5.34	4	205	235	260	47	113	98	
3	55	76.87	1.05	.82	6.69	4	205				113	98	
2	57.5	77.99	.99	.77	7.98	4	207	240	255	47	112	98	
1	60	79.44	.90	.70	9.22	4	206				112	98	
	1915												
	θ = 60	Vm = 34.24		ΔH = .92							Avg. = 102.9		

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S-0037R

INTERPOLL LABORATORIES, INC.
(612) 786-6020

EPA Method 2 Field Data Sheet

Job LP DUNGANNON
Source DRYER STACK
Test 10 Run __ Date ____
Stack Dimen. 41 IN.
Dry Bulb 183 °F Wet bulb 152 °F
Manometer ☒ Reg. ☐ Exp ☐ Elec.
Barometric Pressure 28.62 IN.HG
Static Pressure +.53 IN.WC
Operators KK + MK
Pitot No. 23-6 C_p .84

Drawing of Test Site

Cross-section View	Elevation View

Traverse Point No.	Fraction of Diameter	Distance From Stack Wall (IN.)	Distance From End of Port (IN.)	Velocity	Temp. of Gas (°F)
▨		Port Length:	IN.	Time Start:	HRS
A 1				.93	195
2				.97	
3				1.0	
4				1.1	
5				1.25	
6				1.25	
7				1.20	
8				1.1	
9				1.20	
10				1.1	
11				.96	
12				.91	
B 1				.87	195
2				.95	
3				.99	
4				1.05	
5				1.20	
6				1.25	
7				1.3	
8				1.15	
9				1.10	
10				.97	
11				.93	
12				.82	
Temp. Meas. Device & S/N:	PDI #36			Time End:	HRS

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

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Interpoll Laboratories
(612)786-6020

EPA Method 7 Sample Collection
Field Data Sheet

Job LP/DUNGANNON
Date 6-28-94
Bar. Pressure 28.62 IN.HG.
Test Location Dryer Stack
Fuel Type
Sample Train No. Green
Technician KR+MK
Pump No. Cal

No.	Test Run Point	Flask No.	Time (HRS)	Vacuum (IN.HG.)	Flask Temp. (°F)	Leak Rate <0.4 IN.HG./MIN.
1	10-2-1	55	2052	26.35	74	☒ Yes ☐ No
2	10-2-2	56	2107	26.70	74	☒ Yes ☐ No
3	10-2-3	7	2122	26.75	74	☒ Yes ☐ No
4	10-2-2	9	2137	26.60	73	☒ Yes ☐ No
5	10-3-1	10	2156	26.65	73	☒ Yes ☐ No
6	10-3-3	11	2211	26.75	73	☒ Yes ☐ No
7	10-3-2	12	2226	26.90	72	☒ Yes ☐ No
8	10-3-1	28	2241	26.75	72	☒ Yes ☐ No
9						☐ Yes ☐ No
10						☐ Yes ☐ No
11						☐ Yes ☐ No
12						☐ 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

S-263R

APPENDIX E

PRESS VENT FIELD DATA SHEETS

INTERPOLL LABORATORIES, INC.
(612) 786-6020

EPA Method 2 Field Data Sheet

ob LP/[illegible]
ource [illegible] UNIT STACK
Test 7 Run 0 Date 6-24-9[illegible]
Stack Dimen. 59.5 IN.
Dry Bulb ____ °F Wet bulb ____ °F
Manometer ☒ Reg. ☐ Exp ☐ Elec.
Barometric Pressure 29.02 IN.HG
Static Pressure -.63 IN.WC
Operators F. TROWBRIDGE
Pitot No. 22V-6 C_p .84

Drawing of Test Site

Cross-section View	Elevation View

Traverse Point No.	Fraction of Diameter	Distance From Stack Wall (IN.)	Distance From End of Port (IN.)	Velocity	Temp. of Gas (°F)
▨		Port Length:	6.25 IN.	Time Start: 0851 HRS	
A-1	.021	1.25	7.50	1.37	
2	.067	3.99	10.24	1.50	
3	.118	7.02	13.27	1.59	
4	.177	10.53	16.78	1.54	
5	.250	14.88	21.13	1.50	96
6	.356	21.18	27.43	1.48	
7	.644	38.31	44.56	1.48	
8	.750	44.62	50.87	1.50	
9	.823	48.96	55.22	1.70	
10	.882	52.47	58.73	1.94	
11	.933	55.52	61.76	2.20	
12	.979	58.25	64.50	2.18	
B 1				1.35	
2				1.74	
3				1.80	
4				1.62	
5				1.58	96
6				1.50	
7		FT/sec	74.74	1.42	
8		ACFM	86598	1.40	
9		DSCFM	76573	1.50	
10				1.58	
11				1.68	
12				1.22	
Temp. Meas. Device & S/N: ITT-34				Time End: 0900 HRS	

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

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job LP/DUNGANNON
Source PRESS VENT STACK
Method MDT Filter holder: EKC

Date 6-24-94 Test 7 Run 1
No. of traverse points 24
Filter type: 2½"

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☑
Post test: 0 cfm at 5 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used: 1

Recovery solvent(s)
☐ acetone
☒ other(s) MeCl2

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

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser	20	0	20
Desiccant	1562	1543	19
Total	▨	▨	39

Integrated Gas Sampling Data:

N/A

Bag Pump No. ______
Bag Material: 5-layer Aluminized Tedlar
Pretest leak check: ______
Time start: ______
Sampling rate: ______

Box No. ______ Bag No. ______
Size: 44 L
cc/min at ______ in. Hg.
(HRS) Time end: ______ (HRS)
cc/min Operator: ______

S/N of O_2 Analyzer used to monitor train outlet: ______

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INTERPOLL LABORATORIES METHOD 5 FIELD DATA SHEET

Job LP/DUNGANNON
Source PRESS VENT STACK
Date 6-23-94 Test 7 Run 1

Operators EJ-KL
Meter Box No. 7 ΔH@ 1.74 IN WC
Correction coeff. [illegible]

Pitot No. 22Y-6 Cp .2
Bar. Press. 28.62 in Hg H2O
Nozzle No. 6-3 Nozzle Dia .185 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dgm Vol. (cf)	VAC. tally	Temperatures (°F)						Oxygen
							Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	(%v/v)
	0905	388.10									78	77	
B 1	2.5	390.15	1.60	1.87	0.09	5	96				79	77	
2	5	392.28	1.80	2.08	2.19	5	94				82	78	
3	7.5	394.30	1.70	1.96	4.22	4.8	98				83	79	
4	10	396.36	1.60	1.84	6.20	4	100				84	79	
5	12.5	398.30	1.50	1.73	8.11	4	100				86	80	
6	15	400.10	1.53	1.78	0.06	4	95				87	80	
7	17.5	402.10	1.38	1.61	1.92	5	94				88	81	
8	20	403.90	1.40	1.64	3.79	5	94				89	81	
9	22.5	405.78	1.50	1.76	5.73	3.2	95				90	82	
10	25	407.82	1.70	2.00	7.79	3.8	94				90	82	
11	27.5	409.90	1.70	2.00	9.86	3.8	94				90	82	
12	30	411.70	1.20	1.41	1.60	2.5	95				90	82	
A 1	32.5	413.60	1.[illegible]0	1.88	5.61	3.7	95				90	82	
2	35	415.60	1.54	1.81	5.58	3.7	95				91	83	
3	37.5	417.50	1.50	1.76	7.52	3.5	96				92	83	
4	40	419.40	1.51	1.77	9.47	3.7	96				93	83	
5	42.5	421.41	1.60	1.88	1.48	3.7	96				93	84	
6	45	423.44	1.62	1.91	3.51	4	96				93	84	
7	47.5	425.53	1.44	1.93	5.54	4	96				94	85	
8	50	427.51	1.46	1.74	7.48	3.5	96				94	85	
9	52.5	429.48	1.40	1.65	9.37	3.5	96				95	85	
10	55	431.30	1.18	1.63	1.25	3.4	96				95	85	
11	57.5	433.23	1.50	1.77	3.20	3.8	96				95	85	
12	60	435.40	1.70	2.01	5.28	4	96						
	(1009)												
	θ = 60	Vm = 47.30		ΔH = 1.81							Avg. = 85.5		

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job IP/DUNGANNON
Source PRESS VENT STACK
Method M23 Filter holder: EXT
Date 6-24-94 Test 7 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) ☒
Post test: 0 cfm at √ in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used:

Recovery solvent(s)

☐acetone
☒other(s) MeCl2

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

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1381	1350	31
Total	▨	▨	31

Integrated Gas Sampling Data:

N/A

Bag Pump No.
Bag Material: 5-layer Aluminized Tedlar
Pretest leak check:
Time start:
Sampling rate:
Box No. Bag No.
Size: 44 L
cc/min at in. Hg.
(HRS) Time end: (HRS)
cc/min Operator:

S/N of O_2 Analyzer used to monitor train outlet:

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INTERPOLL LABORATORIES EP METHOD 5 FIELD DATA SHEET

Job CN/DUNGANNON
Source PRESS VENT STACK
Date 6-29-94 Test 7 Run 2

Operators ET-KR
Meter Box No. 9 ΔH@ 1.25 IN WC
Counter coeff. .9961

Pitot No. 221-6 Cp .84
Bar. Press. 29.62 inHg H2O ___ %
Nozzle No. 2-3 Nozzle Dia .185 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dry Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	0	435.60											
A 1	2.5	437.22	1.05	1.20	7.20	3	97				82	81	
2	5	439.10	1.46	1.65	9.07	3	97				85	82	
3	7.5	441.14	1.60	1.82	1.04	3	96				86	82	
4	10	443.16	1.65	1.88	3.05	5	96				88	83	
5	12.5	445.12	1.60	1.83	5.03	3	96				89	83	
6	15	447.25	1.70	1.94	7.07	3.4	96				90	84	
7	17.5	449.20	1.58	1.81	9.04	3	96				91	85	
8	20	451.10	1.50	1.71	0.95	3	100				92	85	
9	22.5	452.90	1.40	1.60	2.81	3	100				93	85	
10	25	454.80	1.62	1.84	4.80	3	102				93	85	
11	27.5	456.82	1.70	1.92	6.84	3	105				94	85	
12	30	458.94	1.83	2.07	8.95	3	105				95	87	
B 1	32.5	460.40	1.05	1.19	0.56	2	105				95	87	
2	35	462.44	1.80	2.04	2.66	3	105				95	87	
3	37.5	464.80	1.80	2.05	4.76	3	104				96	88	
4	40	466.77	1.60	1.82	4.75	3	105				97	88	
5	42.5	468.80	1.64	1.87	8.76	3	105				97	88	
6	45	470.84	1.58	1.80	0.74	3	105				98	89	
7	47.5	472.60	1.60	1.83	2.73	3	102				98	89	
8	50	474.75	1.45	1.66	4.63	3	101				98	90	
9	52.5	476.62	1.50	1.71	6.56	3	105				98	90	
10	55	478.58	1.60	1.82	8.56	3	104				99	90	
11	57.5	480.67	1.82	2.08	0.69	3	103				99	90	
12	60	482.50	1.00	1.14	2.26	2	106				99	90	
	(12.03)												
	θ = 60	Vm = 46.10		ΔH = 1.72							Avg. = 90.0		

S-0037R

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job [illegible]
Date 6-23-94 Test 7 Run 3
Source PRESS VENT STACK
No. of traverse points 24
Method MDI Filter holder: ELC
Filter type: 2 1/2

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Post test: 0 cfm at 5 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used:

Recovery solvent(s)

☐ acetone
☒ other(s) MeCl2

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

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1568	1540	28
Total			28

Integrated Gas Sampling Data:

N/A

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 O_2 Analyzer used to monitor train outlet:

INTERPOLL LABORATORIES F METHOD 5 FIELD DATA SHEET

Job LP Bynum-Tennison
Source PRESS LINE STACK
Date 6-23-94 Test 7 Run 3

Operators ST-KP
Meter Box No. 9 ΔH@ 1.75 In. WC
Console cal'l. 1.924

Pitot No. 22V-6 Cp .83
Bar. Press. 29.62 In.Hg In. H2O %
Nozzle No. 6-3 Nozzle Dia .185 In.

Traverse Point No.		Sampling Time (min)	Sample Volume (cf)	Velocity Head (in.WC)	Orifice Meter (in.WC)	Dry. Vol. (cf)	VAC. in.Hg	Temperature (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
		1244	482.60											
B	1	2.5	484.20	1.00	1.15	4.17	3	102				88	87	
	2	5	486.37	1.80	2.05	6.27	3.0	103				91	87	
	3	7.5	488.48	1.78	2.04	8.37	3.4	103				92	87	
	4	10	490.42	1.60	1.83	0.35	3	106				93	87	
	5	12.5	492.50	1.60	1.83	2.35	3	104				95	89	
	6	15	494.35	1.50	1.72	4.28	3	105				96	90	
	7	17.5	496.20	1.48	1.70	6.20	3	106				97	90	
	8	20	498.14	1.48	1.71	8.13	3	101				98	91	
	9	22.5	500.10	1.60	1.85	0.13	3	104				99	91	
	10	25	502.20	1.72	2.00	2.22	3.2	101				99	91	
	11	27.5	504.14	1.52	1.76	4.18	3	103				99	92	
	12	30	506.06	1.40	1.62	6.06	5.	104				99	92	
A	1	32.5	508.02	1.50	1.73	8.00	3	1.04				98	92	
	2	35	510.01	1.62	1.89	0.03	3	98				101	93	
	3	37.5	512.06	1.64	1.92	2.08	3	99				102	94	
	4	40	514.16	1.60	1.88	4.11	3	98				102	94	
	5	42.5	516.15	1.57	1.84	6.11	3	100				103	94	
	6	45	518.20	1.60	1.88	8.14	3	99				103	94	
	7	47.5	520.32	1.78	2.08	0.28	3	101				104	95	
	8	50	522.30	1.50	1.75	2.23	3	104				104	95	
	9	52.5	524.32	1.48	1.72	4.18	3	106				104	95	
	10	55	526.30	1.70	1.78	6.26	3	105				105	96	
	11	57.5	528.40	1.72	2.01	8.36	3	104				105	96	
	12	60	530.65	1.90	2.22	0.57	4	103				105	97	
		(1344)												
		θ = 60	Vm = 48.05		ΔH 1.84							Avg. = 102.6		

E-7

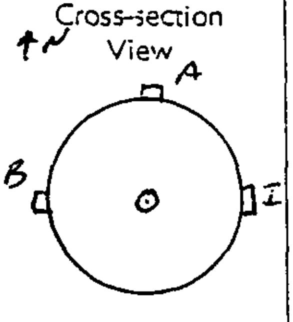
INTERPOLL LABORATORIES, INC.
(612) 786-6020

EPA Method 2 Field Data Sheet

Job L.P. / Dungannon, VA
Source Press Vent / Stack
Test 6 Run 0 Date 6-29-95
Stack Dimen. 59.5 IN.
Dry Bulb 100 °F Wet bulb 68 °F
Manometer ☒ Reg. ☐ Exp ☐ Elec.
Barometric Pressure 28.62 IN.HG
Static Pressure -.63 IN.WC
Operators M. Kuehler + R. Rosenthal
Pitot No. MMS-6 C_p .84

Drawing of Test Site

Cross-section View



Elevation View

Traverse Point No.	Fraction of Diameter	Distance From Stack Wall (IN.)	Distance From End of Port (IN.)	Velocity	Temp. of Gas (°F)
▨		Port Length: 6.25 IN.		Time Start: 0851 HRS	
A-1	.021	1.25	7.50	1.37	
2	.067	3.99	10.24	1.50	
3	.118	7.02	13.27	1.59	
4	.177	10.53	16.78	1.54	
5	.250	14.88	21.13	1.50	
6	.356	21.18	27.43	1.48	
7	.644	38.31	44.56	1.48	
8	.750	44.62	50.87	1.50	
9	.823	48.96	55.22	1.70	
10	.882	52.47	58.73	1.94	↑
11	.933	55.51	61.76	2.20	
12	.979	58.25	64.50	2.18	96
B-1				1.35	
2				1.74	↓
3				1.80	
4				1.62	
5				1.58	
6				1.50	
7				1.42	
8				1.40	
9				1.50	
10				1.58	
11				1.68	
12				1.22	
Temp. Meas. Device & S/N:	PDT-31 / TC			Time End: 0858 HRS	

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

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job L.P. / Dungannon, VA
Source Press Vent / Stack
Method 1-2 PP Filter holder: NA
Date 6-29-94 Test 8 Run 1
No. of traverse points 24
Filter type: NA

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☑
Post test: <0.02 cfm at 13 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used:
NA

Recovery solvent(s)
☑ ~~acetone~~ Acetonitrile
☑ other(s) Toluene

No. of probe wash bottles: 0
Sample recovered by: M. Koehler + K. Rosenthal

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	10	0	10
Impinger No. 2			
~~Impinger No. 3~~ Charcoal	1554	1490	64
Condenser			
Desiccant	1378	1354	24
Total	▨	▨	34

Integrated Gas Sampling Data: NA / Ambient

Bag Pump No. ______
Bag Material: 5-layer Aluminized Tedlar
Pretest leak check: ______
Time start: ______
Sampling rate: ______
Box No. ______ Bag No. ______
Size: 44 L
cc/min at ______ in. Hg.
(HRS) Time end: ______ (HRS)
cc/min Operator: ______

S/N of O_2 Analyzer used to monitor train outlet: ______

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INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job L.P. / Dinguanga, VA
Source Press Vent / Stack
Date 6-29-94 Test 8 Run 1

Operators M. Knecht + K. Rosenthal
Meter Box No. 5 ΔH@ 4.79 in HC
Counter coeff: .9947

Pitot No. MM5-6 Cp .84
Bar. Press. 28.62 inHg H2O 2 %
Nozzle No. Glass 3 Nozzle Dia .194 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)*	Velocity Head (inHC)	Orifice Meter (inHC)	Dev. Vol. (cf)	VAC. inHg	Temperatures (°F)						Oxygen (%v/v)
							Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	
	0905	88.00											
A-12	2.5	90.27	2.20	2.55	0.31	10	96	Ambient		47	90	79	20.9
11	5	92.60	2.23	2.57	2.63	10.5	94	↓	↓		82	79	↓
10	7.5	94.86	2.02	2.32	4.83	10	98			48	84	79	
9	10	96.94	1.71	1.96	6.86	9	100				87	77	
8	12.5	98.80	1.49	1.71	8.75	8	100			48	88	77	
7	15	100.70	1.43	1.66	0.62	2.5	95				91	79	
6	17.5	102.64	1.52	1.77	2.55	8	94			49	92	79	
5	20	104.43	1.50	1.75	4.47	8	94				94	79	
4	22.5	106.37	1.55	1.81	6.43	8	95			51	95	80	
3	25	108.40	1.61	1.98	8.43	8	94				96	81	
2	27.5	110.47	1.51	1.77	0.37	8	94			51	97	81	
1	30	112.25	1.28	1.50	2.16	7	95				97	81	
B-12	32.5	113.91	1.10	1.29	3.92	6	95			51	93	82	
11	35	115.74	1.39	1.62	5.68	7	95				96	83	
10	37.5	117.71	1.52	1.78	7.62	2.5	96			50	98	83	
9	40	119.62	1.51	1.77	9.57	2.5	96				99	83	
8	42.5	121.63	1.53	1.90	1.52	2.5	96			48	99	83	
7	45	123.57	1.47	1.73	3.45	2.5	96				99	83	
6	47.5	125.46	1.49	1.75	5.38	2.5	96			48	100	84	
5	50	127.31	1.43	1.68	7.28	7	96				100	85	
4	52.5	129.26	1.45	1.71	9.19	7.5	96			48	101	85	
3	55	131.15	1.48	1.74	1.12	2.5	96				102	85	
2	57.5	133.11	1.51	1.78	3.08	2.5	96			48	103	85	
1	60	135.13	1.57	1.85	5.07	8	96	↓	↓		103	86	↓
	1009												
	θ = 60	Vm = 47.13		ΔH 1.92							Avg. = 88.1		

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job L.P. / Dungannon, VA
Source Press Vent / Stack
Method 1-2 pp Filter holder: NA
Sample Train Leak Check:

Date 6-24-94 Test 8 Run 2
No. of traverse points 24
Filter type: NA

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Post test ≤ 0.02 cfm at 13 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used:
NA

Recovery solvent(s)
☒ ~~acetone~~ Acetonitrile
☒ other(s) Toluene

No. of probe wash bottles: 0
Sample recovered by: M. Koehler + K. Rosenthal

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	17	0	17
Impinger No. 2			
Impinger No. 3 / Charcoal	1529	1469	60
Condenser			
Desiccant	1492	1467	25
Total	▨	▨	102

Integrated Gas Sampling Data: NA / Ambient

Bag Pump No.
Bag Material: 5-layer Aluminized Tedlar
Pretest leak check:
Time start:
Sampling rate:

Box No. Bag No.
Size: 44 L
cc/min at in. Hg.
(HRS) Time end: (HRS)
cc/min Operator:

S/N of O_2 Analyzer used to monitor train outlet:

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LI-011

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job L.P. / Disputanta, VA
Source Press Vent / stack
Date 6-29-94 Test B Run 2

Operators M. Kuchlert K. Rogenthal
Meter Box No. 5 ΔH@ 1.79 in HC
Counter coeff. .9997

Pitot No. MMS-6 Cp .84
Bar. Press. 28.62 inHg H2O 3.5 %
Nozzle No. Glass-3 Nozzle Dia .184 in.

Traverse Point No.	Sampling Time (min)	Sample Volume* (cf)	Velocity Head (inHC)	Orifice Meter (inHC)	Dev. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	1101	137.00											
B-12	2.5	138.28	1.15	1.31	8.67	6	95	Ambient	Ambient	49	97	94	20.9
11	5	140.61	1.39	1.58	0.49	7	96				94	83	
10	7.5	142.51	1.55	1.77	2.43	7.5	96			49	96	84	
9	10	144.54	1.70	1.94	4.47	8.5	96				98	84	
8	12.5	146.54	1.64	1.88	6.47	8	96			49	100	84	
7	15	148.53	1.60	1.83	8.45	8	96				101	85	
6	17.5	150.48	1.48	1.20	0.36	7.5	96			51	102	86	
5	20	152.42	1.55	1.77	2.31	7.5	100				103	85	
4	22.5	154.37	1.58	1.80	4.27	8	102			51	105	86	
3	25	156.34	1.61	1.84	6.26	8	102				105	87	
2	27.5	158.31	1.64	1.86	8.27	8	105			52	105	87	
1	30	160.24	1.48	1.69	0.17	7.5	105				105	88	
A-12	32.5	162.60	2.35	2.67	2.57	12	105			52	103	89	
11	35	164.97	2.18	2.47	4.97	11	105				103	89	
10	37.5	167.14	1.80	2.07	6.99	9.5	104			50	104	89	
9	40	169.03	1.52	1.73	8.93	8	105				105	90	
8	42.5	170.98	1.60	1.82	0.91	8	105			49	106	90	
7	45	172.94	1.52	1.73	2.85	8	105				106	90	
6	47.5	174.94	1.58	1.81	4.83	8	102			49	107	90	
5	50	176.92	1.55	1.78	6.79	8	101				106	91	
4	52.5	178.75	1.53	1.75	8.74	8	105			49	107	90	
3	55	180.74	1.61	1.83	0.73	9	106				107	90	
2	57.5	182.69	1.55	1.78	2.69	8	103			49	107	90	
1	60	184.70	1.55	1.77	4.65	8	106				107	90	
	(1203)												
	θ = 60	Vm = 47.70		~H 1.84							Avg. =	91.2	

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job L.P. / Dungannon, VA
Source Press Vent / Stack
Method 1-2 PP Filter holder: NA
Date 6-29-94 Test 8 Run 3
No. of traverse points 24
Filter type: NA

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☑
Post test: <0.02 cfm at 12 in. Hg. (vac) ☑

Particulate Catch Data:

No. of filters used: NA

Recovery solvent(s)
☑ ~~acetone~~ Acetonitrile
☑ other(s) Toluene

No. of probe wash bottles: 0
Sample recovered by: M. Kuehlewind + K. Rosenthal

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	12	0	12
Impinger No. 2			
~~Impinger No. 3~~ Charcoal	1540	1490	50
Condenser			
Desiccant	1390	1378	12
Total	▨	▨	24

Integrated Gas Sampling Data: NA / Ambient

Bag Pump No. ____
Bag Material: 5-layer Aluminized Tedlar
Pretest leak check: ____ cc/min at ____ in. Hg.
Time start: ____ (HRS) Time end: ____ (HRS)
Sampling rate: ____ cc/min Operator: ____
Box No. ____ Bag No. ____
Size: 44 L

S/N of O_2 Analyzer used to monitor train outlet: ____

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INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job L.P. / Dungannon, VA
Source Press Vent / Stack
Date 6-29-94 Test 8 Run 3

Operators M. Kachler + K. Rosenthal
Meter Box No. I ∆H@ 1.22 in WC
Gasmeter coeff. .9997

Pitot No. MMS-6 Cp .84
Bar. Press. 29.62 inHg H2O 4.3 %
Nozzle No. Glass-3 Nozzle Dia. .184 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dev. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	12:44	185.10											
A-12	2.5	187.49	2.21	2.47	7.39	10	102	Amb	ient	54	90	89	20.9
11	5	189.73	2.19	2.43	9.66	10	103				93	89	
10	7.5	191.85	1.85	2.06	1.26	9	103			55	97	90	
9	10	193.82	1.61	1.79	3.72	8	106				100	89	
8	12.5	195.75	1.52	1.70	5.64	2.5	104			55	102	90	
7	15	197.62	1.59	1.78	7.60	8	105				103	91	
6	17.5	199.60	1.55	1.74	9.53	2.5	106			54	106	91	
5	20	201.60	1.60	1.81	1.52	2.5	101				106	92	
4	22.5	203.62	1.68	1.89	3.54	8	104			54	109	92	
3	25	205.60	1.50	1.71	5.47	7	101				109	93	
2	27.5	207.49	1.50	1.70	7.39	7	103			52	110	93	
1	30	209.51	1.59	1.80	9.37	7.5	104				110	93	
B-12	32.5	211.15	1.18	1.34	1.08	6	104			51	105	94	
11	35	212.95	1.31	1.50	2.89	6.5	98				110	94	
10	37.5	214.88	1.50	1.72	4.82	7	99			51	110	95	
9	40	216.93	1.60	1.84	6.82	2.5	98				112	95	
8	42.5	218.82	1.51	1.73	8.77	2.5	100			52	113	95	
7	45	220.83	1.43	1.64	0.66	2.5	99				113	95	
6	47.5	222.74	1.49	1.71	2.60	2.5	101			52	114	96	
5	50	224.61	1.49	1.70	4.53	2.5	104				114	97	
4	52.5	226.55	1.53	1.74	6.48	2.5	106			52	114	97	
3	55	228.57	1.64	1.87	8.51	8	105				115	97	
2	57.5	230.52	1.50	1.71	0.45	2.5	104			53	115	97	
1	60	232.44	1.52	1.74	2.40	2.5	103	↓	↓		115	98	↓
	(1347)												
	θ = 60	Vm = 47.34		∆H = 1.80							Avg. =	100.5	

INTERPOLL LABORATORIES, INC.
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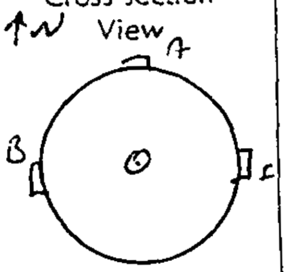
EPA Method 2 Field Data Sheet

ob L.P. / Dungannon, VA
ource Press Vent / Stack
Test 11 Run 0 Date 6-29-94
tack Dimen. 19.5 IN.
ry Bulb 100 °F Wet bulb 69 °F
Manometer ☒Reg. ☐Exp ☐Elec.
arometric Pressure 28.62 IN.HG
tatic Pressure -.63 IN.WC
Operators M. Kuebler + K. Rosenthal
itot No. MM5-6 C_p .84

Drawing of Test Site

Cross-section View



Elevation View

Traverse Point No.	Fraction of Diameter	Distance From Stack Wall (IN.)	Distance From End of Port (IN.)	Velocity	Temp. of Gas (°F)
▒		Port Length: 6.25 IN.		Time Start: NA HRS	
		Refer to Test No. 8 for pts and flows			
Temp. Meas. Device & S/N:		PDT-31 / TC		Time End: NA HRS	

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

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job L.P. / Dungannon, VA
Source Press Vent / Stack
Method 0011 Filter holder: NA
Date 6-29-94 Test 11 Run 1
No. of traverse points 24
Filter type: NA

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☑
Post test: <0.02 cfm at 8 in. Hg. (vac) ☑

Particulate Catch Data:

No. of filters used:
NA

Recovery solvent(s)
☐ acetone
☑ other(s) $MeCl_2$

No. of probe wash bottles: 0
Sample recovered by: M. Kuablent K. Rwanthal

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	480	468	12
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1418	1399	19
Total	▨	▨	31

Integrated Gas Sampling Data: NA / Ambient

Bag Pump No. ____
Bag Material: 5-layer Aluminized Tedlar
Pretest leak check: ____ cc/min at ____ in. Hg.
Time start: ____ (HRS) Time end: ____ (HRS)
Sampling rate: ____ cc/min Operator: ____
Box No. ____ Bag No. ____
Size: 44 L

S/N of O_2 Analyzer used to monitor train outlet: ____

125093-G:\STACK\WP\METHODS\S-0046RR

ENTROPY [illegible] 5 [illegible]

Job L.P. / Dragonneer, VA
Source Press Vent / Stack
Date 6-29-94 Test II Run 1

Operators McKee/West/K. Rosenthal
Meter Box No. 5 ΔH@ 1.79 in WC
Gasmeter coeff. .9997

Pitot No. 1141S-6 Cp .8
Bar. Press. 28.62 in Hg H2O 2.5 %
Nozzle No. Glass-3 Nozzle Dia .194 in.

							Temperature (°F)						Oxygen
Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dry. Vol. (cf)	VAC. inHg	Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	(%v/v)
	1547	232.70						Amb	ient	52	89	90	20.9
B-12	3	234.87	1.20	1.50	4.82	4.5	100				93	90	
11	6	237.21	1.47	1.69	2.14	5	102			52	97	89	
10	9	239.58	1.50	1.74	9.46	5	97				100	90	
9	12	241.86	1.56	1.83	1.83	5	95			53	102	90	
8	15	244.21	1.52	1.78	4.19	5	95				104	90	
7	18	246.65	1.57	1.95	6.58	5	94			54	106	90	
6	21	248.95	1.43	1.69	8.88	5	94				107	91	
5	24	251.25	1.38	1.63	1.13	5	96			51	107	91	
4	27	253.57	1.44	1.69	3.43	5	99				107	92	
3	30	255.90	1.55	1.82	5.91	5	99			50	106	92	
2	33	258.37	1.60	1.90	8.24	5	94				106	92	
1	36	260.69	1.54	1.81	0.62	5	100			49	104	92	
A-12	39	263.64	2.31	2.71	3.52	2.5	98				105	92	
11	42	266.17	1.80	2.12	6.09	6	96			49	106	92	
10	45	268.62	1.63	1.92	9.54	5.5	96				106	92	
9	48	270.97	1.48	1.73	0.87	5	101			49	105	92	
8	51	273.14	1.30	1.52	3.05	5	101				106	92	
7	54	275.40	1.42	1.67	5.33	5	97			51	105	91	
6	57	277.71	1.47	1.73	2.66	5	97				105	91	
5	60	280.12	1.50	1.76	0.00	5	97			51	104	91	
4	63	282.45	1.53	1.81	2.38	5	94				104	91	
3	66	284.88	1.50	1.76	4.71	5	99			50	105	91	
2	69	286.99	1.41	1.65	6.98	5	99				105	91	
1	72	289.23	1.30	1.53	9.17	5	96						
	(1700)												
	θ = 72	Vm = 56.53		ΔH = 1.79							Avg. = 97.2		

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job L.P. / Dungannon, VA
Source Press vent / Stack
Method 0011 Filter holder: NA
Date 6-29-94 Test 11 Run 2
No. of traverse points 24
Filter type: NA

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Post test: <0.02 cfm at 9 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used: NA

Recovery solvent(s)

☐ acetone
☒ other(s) MeCl₂

No. of probe wash bottles: 0
Sample recovered by: M. Koehler + K. Rosenthal /

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	499	477	22
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1499	1488	11
Total	▨	▨	33

Integrated Gas Sampling Data: NA / Ambient

Bag Pump No. ______
Bag Material: 5-layer Aluminized Tedlar
Pretest leak check: ______ cc/min at ______ in. Hg.
Time start: ______ (HRS)
Time end: ______ (HRS)
Sampling rate: ______ cc/min
Operator: ______
Box No. ______ Bag No. ______
Size: 44 L

S/N of O_2 Analyzer used to monitor train outlet: ______

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ENTROPY LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job L.P. / Dungannon, VA.
Source Press Vent / Stack
Date 6-29-94 Test 11 Run 2

Operators M. Koehler + K. Rossetti
Meter Box No. 5 ΔH@ 1.22 in H2O
Console serial Y .9992

Pitot No. MMS-6 Cp [illegible]
Bar. Press. 28.62 inHg H2O 3.8 %
Nozzle No. Glass-3 Nozzle Dia. .194 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inH2O)	Orifice Meter (inH2O)	Dgs. Vol. (cf)	VAC. inHg	Temperature (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	1719	289.50											
A-12	3	292.42	2.21	2.59	2.33	2.5	95	Ambient		49	89	88	20.9
11	6	295.29	2.18	2.51	5.10	2.5	96				95	88	
10	9	297.68	1.78	2.05	7.61	6.5	99			46	97	88	
9	12	300.10	1.59	1.84	0.00	6	97				101	88	
8	15	302.40	1.48	1.73	2.31	5.5	95			43	102	88	
7	18	304.69	1.45	1.20	4.60	5	94				103	87	
6	21	306.97	1.49	1.73	6.92	5	98			44	104	88	
5	24	309.35	1.52	1.79	9.27	5.5	93				103	88	
4	27	311.74	1.58	1.95	1.67	6	95			44	104	88	
3	30	314.10	1.60	1.97	4.07	6	97				105	88	
2	33	316.49	1.54	1.81	6.44	5.5	94			45	105	88	
1	36	318.79	1.37	1.60	8.68	5	96				106	89	
B-12	39	320.87	1.12	1.31	0.70	4.5	96			45	103	89	
11	42	322.99	1.43	1.67	2.98	5	95				104	89	
10	45	325.39	1.52	1.78	5.33	5.5	95			46	104	89	
9	48	327.88	1.57	1.84	7.73	6	94				104	88	
8	51	330.10	1.54	1.81	0.10	5.5	93			47	105	89	
7	54	332.50	1.45	1.69	2.39	5	97				105	89	
6	57	334.73	1.38	1.62	4.63	5	96			47	106	89	
5	60	336.97	1.42	1.65	6.90	5	102				106	89	
4	63	339.27	1.48	1.72	9.21	5.5	100			48	106	89	
3	66	341.59	1.50	1.76	1.55	5.5	96				106	90	
2	69	343.98	1.61	1.92	3.97	5.5	102			48	106	89	
1	72	346.24	1.32	1.54	6.16	5	99				107	99	
	(1932)												
	θ = 72	Vm = 56.74		ΔH = 1.81							Avg. = 95.8		

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job L. P. / Dungannon, VA
Source Press Vent / Stack
Method 0011 Filter holder: NA
Date 6-29-94 Test 11 Run 3
No. of traverse points 24
Filter type: 0

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Post test: <0.02 cfm at 9 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used: NA

Recovery solvent(s)
☐ acetone
☒ other(s) MeCl2

No. of probe wash bottles: 0
Sample recovered by: M. Koehler + K. Rosenthal

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	492	475	17
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1400	1390	10
Total	▨	▨	27

Integrated Gas Sampling Data: NA / Ambient

Bag Pump No.
Bag Material: 5-layer Aluminized Tedlar
Pretest leak check:
Time start:
Sampling rate:
Box No. Bag No.
Size: 44 L
cc/min at in. Hg.
(HRS) Time end: (HRS)
cc/min Operator:

S/N of O_2 Analyzer used to monitor train outlet:

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ENTROPY LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job L.P. / Dungannon, VA
Source Press Vent / Stack
Date 6-29-94 Test 11 Run 3

Operators M. Koeschlag / K. Rosenthal
Meter Box No. 5 ΔH@ 1.27 in H2O
Gasmeter coeff. .9997

Pitot No. MMS-6 Cp [illegible]
Bar. Press. 29.62 in Hg H2O 2.9 %
Nozzle No. Glass-3 Nozzle Dia .184 in.

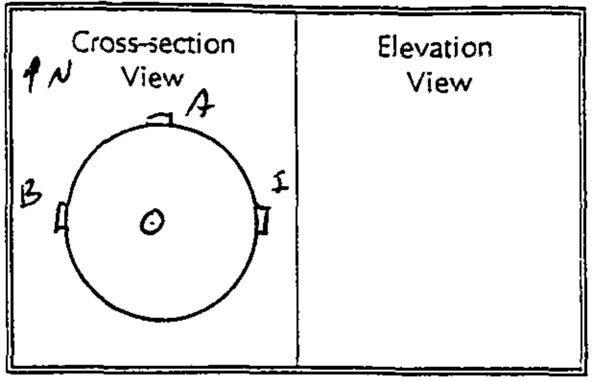
Traverse Point No.	Sampling Time (min)	Sample Volume* (cf)	Velocity Head (in H2O)	Orifice Meter (in H2O)	Del. Vol. (cf)	VAC. in Hg	Temperatures (°F) Stack	Probe	Oven	Imp.	Gas/In	Gas/Out	Oxygen (%v/v)
	1848	346.50											
B-12	3	348.72	1.17	1.36	8.56	4	96	Ambient	Ambient	49	90	88	20.9
11	6	350.95	1.52	1.26	0.88	5	94	↓	↓		95	85	↓
10	9	353.34	1.61	1.87	3.28	5.5	93			51	99	88	
9	12	355.84	1.72	2.00	5.76	6	96				101	88	
8	15	358.05	1.68	1.95	9.22	6	96			52	103	89	
7	18	360.20	1.50	1.76	0.55	5.5	94				104	89	
6	21	362.94	1.49	1.74	2.88	5	96			52	104	88	
5	24	365.30	1.48	1.72	5.19	5	92				105	89	
4	27	367.65	1.58	1.83	2.58	5.5	100			48	105	89	
3	30	369.97	1.55	1.80	9.94	5.5	101				105	90	
2	33	372.40	1.58	1.84	2.34	5.5	97			48	106	90	
1	36	374.50	1.20	1.41	4.43	4.5	96				106	90	
A-12	39	377.32	2.28	2.68	7.32	8	94			49	106	91	
11	42	390.14	2.12	2.46	0.09	2.5	100				107	90	
10	45	392.75	1.84	2.14	2.67	6.5	99			49	106	91	
9	48	395.18	1.60	1.97	5.08	6	92				106	91	
8	51	397.52	1.50	1.76	2.43	5.5	94			50	106	91	
7	54	399.04	1.50	1.74	9.26	5.5	102				108	91	
6	57	392.02	1.53	1.78	2.12	5.5	100			51	109	91	
5	60	394.52	1.57	1.84	4.52	6	96				109	91	
4	63	396.85	1.54	1.79	6.89	5.5	101			51	110	91	
3	66	399.30	1.55	1.81	9.26	5.5	101				110	92	
2	69	401.52	1.42	1.66	1.55	5	99			50	110	92	
1	72	403.94	1.44	1.75	3.89	5.5	98	↓	↓		110	92	↓
	2001												
	θ = 72	Vm = 57.44		ΔH 1.85							Avg. = 97.4		

INTERPOLL LABORATORIES, INC.
(612) 786-6020

EPA Method 2 Field Data Sheet

Job L.P. / Dungannon, VA
Source Press Vent / Stack
Test 12 Run 0 Date 6-29-94
Stack Dimen. 59.5 IN.
Dry Bulb 100 °F Wet bulb 69 °F
Manometer ☑ Reg. ☐ Exp ☐ Elec.
Barometric Pressure 28.62 IN.HG
Static Pressure -.63 IN.WC
Operators M. Koehler + K. Rosenthal
Pitot No. C5

Drawing of Test Site



Traverse Point No.	Fraction of Diameter	Distance From Stack Wall (IN.)	Distance From End of Port (IN.)	Velocity	Temp. of Gas (°F)
▨		Port Length: 6.25 IN.		Time Start: NA HRS	
I-1	1/6	9.92	16.17		
2	3/6	29.75	36.00		
3	5/6	49.58	55.83		
Temp. Meas. Device & S/N: PDT-31 / TC				Time End: NA HRS	

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

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INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job L.P. / Dungannon, VA
Source Press vent / Stack
Method Plenc/ Filter holder: NA
Date 6-29-94 Test 12 Run 1
No. of traverse points 3
Filter type: NA

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Post test: <0.02 cfm at 12 in. Hg. (vac) ☑

Particulate Catch Data:

No. of filters used:
NA

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

No. of probe wash bottles: 0
Sample recovered by: M. Kuechler + K. Rosenthal

Condensate Data:

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

Integrated Gas Sampling Data: NA / Ambient

Bag Pump No.
Bag Material: 5-layer Aluminized Tedlar
Pretest leak check:
Time start:
Sampling rate:
Box No. Bag No.
Size: 44 L
cc/min at in. Hg.
(HRS) Time end: (HRS)
cc/min Operator:

S/N of O_2 Analyzer used to monitor train outlet:

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INTERPOLL LABORATORIES

EPA Method 4 and 6 Field Data Sheet

Job I.P. / Dungannon
Source Press Vent / Stack
Date 6-29-94 Test 12 Run 1

Operator(s) M. Kaehler + K. Rosenthal
Meter Box No. 9 Gasmeter coef. .9961
^H@ 1.79 in.WC Bar. press 28.62 in.Hg

Sample Train Leak Check:
Pretest: < 0.02 cfm at 15 in. Hg.
Posttest: <0.02 cfm at 11 in. Hg.

Trav. Point No.	Samp. Time (min)	Sample Volume (cf)	Orif. Meter (inWC)	VAC. inHg	Temperatures (°F)					Oxygen
					Probe	Oven	Impg.	Gas/In	Gas/Out	(%v/v)
▤	1549	531.00	▤	▤	▤	▤	▤	▤	▤	▤
A-3	5	535.08	1.78	9	Ambient		48	87	97	20.9
3	10	539.15	1.78	9			48	90	88	
3	15	543.16	1.78	9			49	93	89	
3	20	547.21	1.78	9			49	94	89	
2	25	551.26	1.78	9			46	96	89	
2	30	555.28	1.78	9			45	96	90	
2	35	559.30	1.78	9			45	96	90	
2	40	563.41	1.78	9			46	96	90	
1	45	567.50	1.78	9			46	96	90	
1	50	571.59	1.78	9			48	96	90	
1	55	575.56	1.78	9			49	97	90	
1	60	579.64	1.78	9	↓	↓	49	96	89	↓
	(1649)									
▤	θ= 60	V_m= 48.64	$(\hat{}H)_{avg}$= 1.78		▤	▤	▤	$(t_m)_{avg}$= 91.83		▤

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impingers A	280	267	13
~~Condenser~~ B	269	267	2
Desiccant	1511	1492	19
▤	▤	Total	34

Preliminary results of SO_2 concentration determination

V_{std} = 44.55 DSCF
Moisture = 3.47 %v/v
SO_2, dry = ppm
SO_2, wet = ppm
LB/MMBtu =

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job L.P. / Dungannon, VA
Source Press Vent / Stack
Method Phenol Filter holder: NA
Date 6-29-94 Test 12 Run 2
No. of traverse points 3
Filter type: NA

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Post test: <0.02 cfm at 12 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used:
NA

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

No. of probe wash bottles: 0
Sample recovered by: M. Kuhlert + K. Rosenthal

Condensate Data:

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

Integrated Gas Sampling Data: NA / Ambient

Bag Pump No.
Bag Material: 5-layer Aluminized Tedlar
Pretest leak check:
Time start:
Sampling rate:
Box No. Bag No.
Size: 44 L
cc/min at in. Hg.
(HRS) Time end: (HRS)
cc/min Operator:

S/N of O_2 Analyzer used to monitor train outlet:

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INTERPOLL LABORATORIES

EPA Method 4 and 6 Field Data Sheet

Job I.P. / Dinganson, VA
Source Press vent / Stack
Date 6-29-94 Test 12 Run 2

Operator(s) M. Kochler & K. Rosenthal
Meter Box No. 9 Gasmeter coef. .9961
^H@ 1.78 in.WC Bar. press 28.62 in.Hg

Sample Train Leak Check:
Pretest: < 0.02 cfm at 15 in. Hg.
Posttest: < 0.02 cfm at 14 in. Hg.

Trav. Point No.	Samp. Time (min)	Sample Volume (cf)	Orif. Meter (inWC)	VAC. inHg	Temperatures (°F) Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	1720	580.00								
B 3	5	584.12	1.78	9	Ambient		47	84	84	20.9
3	10	588.05	1.78	9			48	88	84	
3	15	592.02	1.78	9			48	90	85	
3	20	596.04	1.78	9			49	91	85	
2	25	600.02	1.78	9			46	91	85	
2	30	604.02	1.78	9			46	92	86	
2	35	608.05	1.78	9			46	93	85	
2	40	612.05	1.78	9			46	93	85	
1	45	616.07	1.78	9			47	92	85	
1	50	620.14	1.78	9			47	93	86	
1	55	624.19	1.78	9			47	93	86	
1	60	628.20	1.79	9			47	94	87	
	(1822)									
	θ= 60	Vm= 48.20	(^H)avg= 1.78					(tm)avg.= 88.21		

Condensate Data:

Item	Weight (g) Final	Tare	Difference
Impingers	280	267	13
Condenser B	268	265	3
Desiccant	1390	1375	15
		Total	31

Preliminary results of SO_2 concentration determination

V_{std} = 44.48 DSCF
Moisture = 3.18 %v/v
SO_2, dry = ppm
SO_2, wet = ppm
LB/MMBtu =

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Interpoll Laboratories EPA Method 5/17 Sample Log Sheet

Job L.P. / Dungannon, VA
Date 6-29-94 Test 12 Run 3
Source Press Vent / Stack
No. of traverse points 3
Method Phenol Filter holder: NA
Filter type: NA

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Post test: <0.02 cfm at 12 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used:
NA

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

No. of probe wash bottles: 0
Sample recovered by: M. Kuehler + K. Auenthal

Condensate Data:

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

Integrated Gas Sampling Data: NA / Ambient

Bag Pump No.
Box No. Bag No.
Bag Material: 5-layer Aluminized Tedlar
Size: 44 L
Pretest leak check: cc/min at in. Hg.
Time start: (HRS) Time end: (HRS)
Sampling rate: cc/min Operator:

S/N of O_2 Analyzer used to monitor train outlet:

123093-G:\STACK\WP\METHODS\S-0046RR

INTERPOLL LABORATORIES

EPA Method 4 and 6 Field Data Sheet

Job L.P. / Dungannon, VA
Source Press Vent / Stack
Date 6-24-94 Test 12 Run 3

Operator(s) M. Koehler & K. Rosenthal
Meter Box No. 9 Gasmeter coef. .9961
^H@ 1.78 in.WC Bar. press 28.62 in.Hg

Sample Train Leak Check:
Pretest: < 0.02 cfm at 15 in. Hg. ✓
Posttest: <0.02 cfm at 15 in. Hg. ✓

Trav. Point No.	Samp. Time (min)	Sample Volume (cf)	Orif. Meter (inWC)	VAC. inHg	Temperatures (°F) Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
▤	1927	629.60	▤	▤	▤	▤	▤	▤	▤	▤
B-3	5	632.64	1.79	9	Ambient		48	89	85	20.9
3	10	636.70	1.79	9			48	92	85	
3	15	640.76	1.79	9			49	93	86	
3	20	644.83	1.79	9			49	93	86	
2	25	648.85	1.79	9			49	93	86	
2	30	652.98	1.79	9			49	93	87	
2	35	656.95	1.79	9			51	94	87	
2	40	660.94	1.79	9			51	95	88	
1	45	665.00	1.79	9			48	95	88	
1	50	669.10	1.79	9			48	95	88	
1	55	673.11	1.79	9			48	96	89	
1	60	677.16	1.79	9	↓	↓	48	97	89	↓
	(1927)									
▤	θ= 60	V 48.56	(^H)avg = 1.79		▤	▤	▤	(tm)'avg. = 90.38		▤

Condensate Data:

Item	Weight(g) Final	Tare	Difference
Impingers A	279	265	14
~~Condenser~~ B	269	267	2
Desiccant	1440	1427	13
▤		Total	29

Preliminary results of SO_2 concentration determination
V_{std} = 44.60 DSCF
Moisture = 2.97 %v/v
SO_2, dry = ppm
SO_2, wet = ppm
LB/MMBtu =

APPENDIX F

INTERPOLL LABORATORIES ANALYTICAL DATA

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Interpoll Laboratories
(612) 786-6020

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job L.P Dungannon
…am Leader er
…te Submitted 7-1-94
Test No. 1
Date of Analysis 7-1-94

Source Thermal Oil Heater
Test Site Stack
Date of Test 6-28-94
No. of Runs Completed 3
Technician C. Helgeson

Test/ Run	Sample Log Number and Type	No. of An.	Buret Readings (ml) Zero Pt.	Buret Readings (ml) After CO_2	Buret Readings (ml) After O_2	Conc. CO_2 %v/v Dry	Conc. O_2 %v/v Dry	F_o
1/1	3252-05	1	0.00	2.20	20.80	2.20	18.60	1.05
		2	0.00	2.20	20.80	2.20	18.60	1.05
	☑ B ☐ F	Avg				2.20	18.60	
1/2	-06	1	0.00	2.00	20.80	2.00	18.80	1.05
		2	0.00	2.00	20.80	2.00	18.80	1.05
	☑ B ☐ F	Avg				2.00	18.80	
1/3	-07	1	0.00	2.10	20.90	2.10	18.80	1.00
		2	0.00	2.10	20.90	2.10	18.80	1.00
	☑ B ☐ F	Avg				2.10	18.80	
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						

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

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

EPA Method 3 Guidelines

Fuel Type	F0 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

waste

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

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EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job L.P. Dungannon
Team Leader MK
Date Submitted 7-1-94
Test No. 2
Date of Analysis 7-1-94

Source Dryer
Test Site Stack
Date of Test 6-28-94
No. of Runs Completed 3
Technician C. Helgeson

Test/ Run	Sample Log Number and Type	No. of An.	Buret Readings (ml)			Conc. CO_2 %v/v Dry	Conc. O_2 %v/v Dry	F_o
			Zero Pt.	After CO_2	After O_2			
2/1	3252-13	1	0.00	2.30	20.90	2.30	18.60	1.00
		2	0.00	2.30	20.90	2.30	18.60	1.00
	☑ B ☐ F	Avg				2.30	18.60	
2/2	-14	1	0.00	2.30	20.90	2.30	18.60	1.00
		2	0.00	2.30	20.90	2.30	18.60	1.00
	☑ B ☐ F	Avg				2.30	18.60	
2/3	-15	1	0.00	2.10	21.00	2.10	18.90	1.00
		2	0.00	2.10	21.00	2.10	18.90	1.00
	☑ B ☐ F	Avg				2.10	18.90	
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	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	F0 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

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EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job L.P. Dungannon
am Leader CT
te Submitted 7-1-94
Test No. 3
Date of Analysis 7-1-94

Source Thermal Oil Heater
Test Site Stack
Date of Test 6-28-94
No. of Runs Completed 3
Technician C. Helgeson

Test/ Run	Sample Log Number and Type	No. of An.	Buret Readings (ml)			Conc. CO_2 %v/v Dry	Conc. O_2 %v/v Dry	F_0
			Zero Pt.	After CO_2	After O_2			
3/1	3252- 20	1	0.00	2.70	20.80	2.70	18.10	1.04
		2	0.00	2.70	20.80	2.70	18.10	1.04
	☑ B ☐ F	Avg				2.70	18.10	
3/2	-21	1	0.00	1.90	20.90	1.90	19.00	1.00
		2	0.00	1.90	20.90	1.90	19.00	1.00
	☑ B ☐ F	Avg				1.90	19.00	
3/3	-22	1	0.00	2.30	20.90	2.30	18.60	1.00
		2	0.00	2.30	20.90	2.30	18.60	1.00
	☑ B ☐ F	Avg				2.30	18.60	
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						

☑ Ambient Air QA Check
☑ Orsat Analyzer System Leak Check
☐ F_0 Within EPA M-3 Guidelines for fuel type.

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

EPA Method 3 Guidelines

Fuel Type	F0 Range
Coal:	
Anthracite/Lignite	1.016-1.130
Bituminous	1.083-1.230
Oil:	
Distillate	1.260-1.413
Residual	1.210-1.370
Gas:	
Natural	1.600-1.836
Propane	1.434-1.586
Butane	1.405-1.553
Wood/Wood Bark	1.000-1.130

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

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EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job L.P. Dungannon
Team Leader MK
Date Submitted 7-1-94
Test No. 6
Date of Analysis 7-1-94

Source Dryer
Test Site Stack
Date of Test 6-28-94
No. of Runs Completed 3
Technician C. Helgeson

Test/Run	Sample Log Number and Type	No. of An.	Buret Readings (ml)			Conc. CO_2 %v/v Dry	Conc. O_2 %v/v Dry	F_o
			Zero Pt.	After CO_2	After O_2			
6/1	3252-20	1	0.00	2.70	20.90	2.70	18.20	1.00
		2	0.00	2.70	20.90	2.70	18.20	1.00
	☑ B ☐ F	Avg				2.70	18.20	
6/2	-21	1	0.00	2.70	20.90	2.70	18.20	1.00
		2	0.00	2.70	20.90	2.70	18.20	1.00
	☑ B ☐ F	Avg				2.70	18.20	
6/3	-22	1	0.00	2.80	20.90	2.80	18.10	1.00
		2	0.00	2.80	20.90	2.80	18.10	1.00
	☑ B ☐ F	Avg				2.80	18.10	
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	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	F0 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

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

Job L.P. Dungannon
Team Leader CT
Date Submitted 7-1-94
Test No. 1
Date of Analysis 7-13-94

Source Thermal Oil Heater
Test Site Stack
Date of Test 6-28-94
No. of Runs Completed 3
Technician C. Helgeson

		Solvent Phase	Aqueous Phase
0	Test 1 Run 0 Field Blank Log Number 3252-01I Comments	Dish No. 17 Dish Tare Wt. 48.3915 g Dish+Sample Wt. 48.3917 g Sample Wt. 0.0002 g	Dish No. C.T. ~~17~~ 212 Dish Tare Wt. 50.9565 g Dish+Sample Wt. 50.9569 g Sample Wt. 0.0004 g
1	Test 1 Run 1 Log Number -02I Comments	Dish No. 21 Dish Tare Wt. 47.5279 g Dish+Sample Wt. 47.5380 g Sample Wt. 0.0101 g	Dish No. 321 Dish Tare Wt. 43.4731 g Dish+Sample Wt. 43.4871 g Sample Wt. 0.0140 g
2	Test 1 Run 2 Log Number -03I Comments	Dish No. 47 Dish Tare Wt. 48.4657 g Dish+Sample Wt. 48.4751 g Sample Wt. 0.0094 g	Dish No. 322 Dish Tare Wt. 44.2283 g Dish+Sample Wt. 44.2401 g Sample Wt. 0.0118 g
3	Test 1 Run 3 Log Number -04I Comments	Dish No. 93 Dish Tare Wt. 53.9848 g Dish+Sample Wt. 53.9866 g Sample Wt. 0.0018 g	Dish No. 622 Dish Tare Wt. 48.8451 g Dish+Sample Wt. 48.8538 g Sample Wt. 0.0087 g
4	Test Run Log Number Comments	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g
5	Test Run Log Number Comments	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g

Results Solvent Phase:

Blank Solvent Wt. 0.0002 g

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0099	0.0092	0.0016		

Results Aqueous Phase:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0136	0.0114	0.0083		

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EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job LP Dungannon
Team Leader ET
Date Submitted 7-1-94
Test No. 1
Date of Analysis 7-13-94
Transport Leakage ☐ None ☐ ______ ml

Source Thermal Oil Heater
Test Site Stack
Date of Test 6-28-94
No. of Runs Completed 3
Technician C. GIERKE
Solvent Acetone

0
Test 1 Run 0
Field Blank
Log Number 3252-01P
Vol. of Solvent 130 ml
*Solvent Residue 3.85 ug/ml
Dish No. 41
Dish Tare Wt. 45.3215 g
Dish+Sample Wt. 45.3220 g
Sample Wt. 0.0005 g

1
Test 1 Run 1
Vol. of Solvent 130 ml
Log Number -02P
Comments ______
Dish No. 513
Dish Tare Wt. 47.4140 g
Dish+Sample Wt. 47.4414 g
Sample Wt. 0.0274 g

2
Test 1 Run 2
Vol. of Solvent 130 ml
Log Number -03P
Comments ______
Dish No. 522
Dish Tare Wt. 47.0009 g
Dish+Sample Wt. 47.0231 g
Sample Wt. 0.0222 g

3
Test 1 Run 3
Vol. of Solvent 130 ml
Log Number -04P
Comments ______
Dish No. 616
Dish Tare Wt. 50.9230 g
Dish+Sample Wt. 50.9407 g
Sample Wt. 0.0177 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 3.85 ug/ml = [(Sample Wt. 0.0005 g)(10^6)]/Vol. of Sol. 130 ml
EPA-M5 Acetone Residue Blank Spec. ≤7.3 ug/ml

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0269	0.0217	0.0172		

LSC-01YR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job LP Dungannon
Team Leader ET
Date Submitted 7-1-94
Test No. 1
Date of Analysis 7-12-94

Source Thermal oil heater
Test Site Stack
Date of Test 6-28-94
No. of Runs Completed 3
Technician C. Gierke

0
Test 1 Run 0
Field Blank
Log Number 3252-01F
Comments

Filter No. 6727
Filter Type 4" GF
Filter Tare Wt. .9435 g
Filter+Sample Wt. .9436 g
Sample Wt. 0.0001 g

1
Test 1 Run 1
Log Number -02F
Comments

Filter No. 6725
Filter Type 4" GF
Filter Tare Wt. .9360 g
Filter+Sample Wt. .9450 g
Sample Wt. 0.0090 g

2
Test 1 Run 2
Log Number -03F
Comments

Filter No. 6726
Filter Type 4" GF
Filter Tare Wt. .9391 g
Filter+Sample Wt. .9506 g
Sample Wt. 0.0115 g

3
Test 1 Run 3
Log Number -04F
Comments

Filter No. 6728
Filter Type 4" GF
Filter Tare Wt. .9314 g
Filter+Sample Wt. .9408 g
Sample Wt. 0.0094 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
	0.0090	0.0115	0.0094		

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

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

Job L.P. Dungannon
Team Leader MK
Date Submitted 7-1-94
Test No. 6
Date of Analysis 7-13-94

Source Dryer
Test Site Stack
Date of Test 6-28-94
No. of Runs Completed 3
Technician C. Helgeson

		Solvent Phase	Aqueous Phase
0	Test ____ Run 0 Field Blank 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
1	Test 6 Run 1 Log Number 3252-231 Comments ____	Dish No. 1 Dish Tare Wt. 51.9702 g Dish+Sample Wt. 51.9820 g Sample Wt. 0.0118 g	Dish No. 64 Dish Tare Wt. 43.1471 g Dish+Sample Wt. 43.1641 g Sample Wt. 0.0170 g
2	Test 6 Run 2 Log Number -241 Comments ____	Dish No. 20 Dish Tare Wt. 48.8140 g Dish+Sample Wt. 48.8202 g Sample Wt. 0.0062 g	Dish No. 175 Dish Tare Wt. 53.0286 g Dish+Sample Wt. 53.0359 g Sample Wt. 0.0073 g
3	Test 6 Run 3 Log Number -251 Comments ____	Dish No. 29 Dish Tare Wt. 48.8861 g Dish+Sample Wt. 48.9017 g Sample Wt. 0.0156 g	Dish No. 314 Dish Tare Wt. 44.0339 g Dish+Sample Wt. 44.0509 g Sample Wt. 0.0170 g
4	Test ____ Run ____ Log Number ____ Comments ____	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g
5	Test ____ Run ____ Log Number ____ Comments ____	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g

Results Solvent Phase:

Blank Solvent Wt. 0.0002 g

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0116	0.0060	0.0154		

Results Aqueous Phase:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0166	0.0069	0.0166		

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EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job L.P. Dungannon
Team Leader MK
Date Submitted 7-1-94
Test No. 6
Date of Analysis 7-14-94
Transport Leakage ☒ None ☐ ______ml

Source Dryer
Test Site Stack
Date of Test 6-28-94
No. of Runs Completed 3
Technician C. GIERKE
Solvent Acetone

0
Test ______ Run 0
Field Blank
Log Number ______
Vol. of Solvent ______ml
*Solvent Residue 3.85 ug/ml
Dish No. ______
Dish Tare Wt. ______ g
Dish+Sample Wt. ______ g
Sample Wt. ______ g

1
Test 6 Run 1
Vol. of Solvent 200 ml
Log Number 3252-23P
Comments ______
Dish No. 100
Dish Tare Wt. 45.9680 g
Dish+Sample Wt 46.0264 g
Sample Wt. 0.0584 g

2
Test 6 Run 2
Vol. of Solvent 170 ml
Log Number -24P
Comments ______
Dish No. 106
Dish Tare Wt. 43.0164 g
Dish+Sample Wt. 43.0374 g
Sample Wt. 0.0210 g

3
Test 6 Run 3
Vol. of Solvent 210 ml
Log Number -25P
Comments ______
Dish No. 313
Dish Tare Wt. 46.4577 g
Dish+Sample Wt 46.4778 g
Sample Wt. 0.0201 g

4
Test ______ Run ______
Vol. of Solvent ______ml
Log Number ______
Comments ______
Dish No. ______
Dish Tare Wt. ______ g
Dish+Sample Wt. ______ g
Sample Wt. ______ g

5
Test ______ Run ______
Vol. of Solvent ______ml
Log Number ______
Comments ______
Dish No. ______
Dish Tare Wt. ______ g
Dish+Sample Wt. ______ g
Sample Wt. ______ g

*Solvent Residue ___ug/ml = [(Sample Wt. ______g)(10^6)]/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
	0.0576	0.0203	0.0193		

Interpoll Laboratories
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EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job LP/Dungannon
Team Leader MC
Date Submitted 7-1-94
Test No. 6
Date of Analysis 7-12-94

Source Dryer
Test Site Stack
Date of Test 6-28-94
No. of Runs Completed 3
Technician C. Gierke

0
Test ____ **Run** 0
Field Blank
Log Number ____
Comments ____
Filter No. ____
Filter Type ____
Filter Tare Wt. ____ g
Filter+Sample Wt. ____ g
Sample Wt. ____ g

1
Test 6 **Run** 1
Log Number 3252-23F
Comments ____
Filter No. 6724
Filter Type 4" GF
Filter Tare Wt. .9276 g
Filter+Sample Wt. .9811 g
Sample Wt. 0.0535 g

2
Test 6 **Run** 2
Log Number -24F
Comments ____
Filter No. 6716
Filter Type 4" GF
Filter Tare Wt. .9361 g
Filter+Sample Wt. .9893 g
Sample Wt. 0.0532 g

3
Test 6 **Run** 3
Log Number -25F
Comments ____
Filter No. 6717
Filter Type 4" GF
Filter Tare Wt. .9300 g
Filter+Sample Wt. .9921 g
Sample Wt. 0.0621 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
	0.0535	0.0532	0.0621		

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

LSC-02PR

Interpoll Laboratories, Inc.
(612)786-6020

Ion Chromatography Laboratory

DIONEX MODEL 4000i WITH ANION MICRO MEMBRANE SUPRESSION

Analyst: KLG

Date of Analysis: 7-19-94

Job: LP Dungannon

Source: Thermal Oil Heater

Site: Stack

Chromatography Conditions

Column		Flow Rate	Eluent	Flow Rate	Suppressor Acid
☐	AS3	ml/min	2.4 mM Na_2CO_3 & 3.0 mM $NaHCO_3$	1.0 ml/min	~~12.5~~ 25 mM Sulfuric Acid
☒	AS4A	2.0 ml/min	1.8 mM Na_2CO_3 & 1.7 mM $NaHCO_3$	ml/min	
☐	AS5	ml/min	100 mM NaOH	☒	Isocratic
☐		ml/min		☐	Gradient(List program below)

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

Results of Sulfate Determination

Sample Name	Interpoll Log Number	Tot. Sample Volume (ml)	Dilution	Solution Conc.(ug/ml)	Total ug Sulfate	meq of Sulfate
1/0 Thermal oil	3252-01	200	1	0.111	22.2	
1 Heater	-02	240	20	1.38	6620	
2	-03	240	20	1.19	5710	
3 ↓	-04	250	20	1.09	5450	
6/1 Dryer	-23	350	1	1.27	445	
2 Stack	-24	340	1	0.169	57.5	
3 ↓	-25	360	1	0.192	69.1	

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

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job LP Dungannon
Team Leader ET
Date Submitted 7-1-94
Test No. 3
Date of Analysis 7-14-94
Transport Leakage ☒ None ☐ ______ ml

Source Thermal Oil Heater
Test Site Stack
Date of Test 6-28-94
No. of Runs Completed 3
Technician C. Bierke
Solvent Acetone

0	Test ____ Run 0 Field Blank Log Number ______ Vol. of Solvent ____ ml *Solvent Residue 3.85 ug/ml	Dish No. ______ Dish Tare Wt. ______ g Dish+Sample Wt. ______ g Sample Wt. ______ g	
1	Test 3 Run 1 Vol. of Solvent 70 ml Log Number 3252-17P Comments ______	Dish No. 43 Dish Tare Wt. 47.3886 g Dish+Sample Wt. 47.3921 g Sample Wt. 0.0035 g	
2	Test 3 Run 2 Vol. of Solvent 100 ml Log Number -18P Comments ______	Dish No. 52 Dish Tare Wt. 49.8059 g Dish+Sample Wt. 49.8205 g Sample Wt. 0.0146 g	
3	Test 3 Run 3 Vol. of Solvent 80 ml Log Number -19P Comments ______	Dish No. 325 Dish Tare Wt. 47.6628 g Dish+Sample Wt. 47.6672 g Sample Wt. 0.0044 g	
4	Test ____ Run ____ Vol. of Solvent ____ ml Log Number ______ Comments ______	Dish No. ______ Dish Tare Wt. ______ g Dish+Sample Wt. ______ g Sample Wt. ______ g	
5	Test ____ Run ____ Vol. of Solvent ____ ml Log Number ______ Comments ______	Dish No. ______ Dish Tare Wt. ______ g Dish+Sample Wt. ______ g Sample Wt. ______ g	

*Solvent Residue ___ug/ml=[(Sample Wt. _____g)(10^6)]/Vol. of Sol. _____ml
EPA-M5 Acetone Residue Blank Spec. <7.8 ug/ml

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0032	0.0142	0.0041		

LSC-01YR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job LP/Dungannon
Team Leader ET
Date Submitted 7-1-94
Test No. 3
Date of Analysis 7-12-94

Source thermal oil Heater
Test Site Stack
Date of Test 6-28-94
No. of Runs Completed 3
Technician C. GIERKE

0
Test 3 Run 0
Field Blank
Log Number 3252-16F
Comments

Filter No. 6222
Filter Type 2.5 GF
Filter Tare Wt. .2615 g
Filter+Sample Wt. .2618 g
Sample Wt. 0.0003 g

1
Test 3 Run 1
Log Number -17F
Comments

Filter No. 6211
Filter Type 2.5 GF
Filter Tara Wt. .2615 g
Filter+Sample Wt. .2710 g
Sample Wt. 0.0095 g

2
Test 3 Run 2
Log Number -18 F
Comments

Filter No. 6214
Filter Type 2.5 GF
Filter Tare Wt. .2573 g
Filter+Sample Wt. .2681 g
Sample Wt. 0.0108 g

3
Test 3 Run 3
Log Number -19F
Comments

Filter No. 6213
Filter Type 2.5 GF
Filter Tare Wt. .2591 g
Filter+Sample Wt. .2684 g
Sample Wt. 0.0093 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
	0.0095	0.0108	0.0093		

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0127	0.0250	0.0134		

LSC-02PR

Dr 7/20/94

Interpoll Laboratories
(612)786-6020

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

**************SOURCE*************
Job L.P. Dungannon
Source Dryer Stack
Date of Sampling 6-28-94
Test No(s) 10

**************RECOVERY****************
Date of Recovery 7-7-94
Recovered by C. G./C.H.
Recovery volume 500 ml ml
Barometric at time 29.005 IN.HG.

*************ANALYTICAL************
Date of Analysis 7-14-94
Analyst KLO
Eluent BS/A
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 Intergrator. 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.

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

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

S-340(1)

Interpoll Laboratories
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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) ($M_{NO_3^-}$)
				t_f (°F)	+	-	Δ Pg (IN.HG.)			Uncorr. for blank C_{RS}	Corr. for blank ($C_{RS} - \bar{C}_B$)	
1	3252-44	55	10-2-1	76°		✓	2.2		1	0.2903	0.2903	150
2	-45	56	10-2-2			✓	1.4		1	0.3731	0.3731	190
3	-46	7	10-2-3			✓	2.5		1	0.3127	0.3127	160
4	-47	9	10-2-2			✓	0.6		1	0.3048	0.3048	150
5	-48	10	10-3-1			✓	0.7		1	0.0754	0.0756	~~[illegible]~~ 38.0
6	-49	11	10-3-3			✓	0.5		1	0.0684	0.0684	34.0
7	-50	12	10-3-2		✓		0.2		1	0.0590	0.0590	30.0
8	-51	28	10-3-1				—		1	0.0661	0.0661	33.0
9												
10												
11												
12												
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		

$\bar{C}_B$ = _____

S-340(2) R-9/85

INTERPOLL LABORATORIES INC.

Formaldehyde Results Using EPA Method 0011
For Dept. 20/LP Dungannon
Collected 6/26-29/94

	Field Spike #1			Test: 2			Source: Dryer Stack
	Actual	Found	% Recovery	Run 0	Run 1	Run 2	Run 3
Log #		(3252-09)		(3252-08)	(3252-10)	(3252-11)	(3252-12)
Mass (ug)*	750	619	82.5	1.04	4390	10800	5400

	Test: 11			Source: Press Vent Stack
	Run 0	Run 1	Run 2	Run 3
Log #		(3252-33)	(3252-34)	(3252-35)
Mass (ug)*		7080	5770	6140

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

Reviewed by:

Gregg W. Holman

INTERPOLL LABORATORIES INC.

4,4-Methylenebis(phenyl isocyanate) Results Using The EPA 1,2-PP Draft Method
For Dept. 20/LP Dungannon Collected 6/29/94

	Field Spike			Test: 8			Source: Press Vent Stack
Item	Actual	Found	% Rec.	Run 0	Run 1	Run 2	Run 3
Log #	[redacted]	3252-SPK	[redacted]	3252-29	3252-30	3252-31	3252-32
MDI (ug)*	296	282	95	< 2.5	206	202	132

* = Total Mass of MDI in the Sample in ug.

Reviewed By:

Gregg W. Hol

Gregg W. Holman

INTERPOLL LABORATORIES INC.

4,4-Methylenebis(phenyl isocyanate) Results
Using the N-p-Nitrobenzyl-N-Propylamine Normal Phase HPLC Method
For Dept. 20/LP Dungannon
Collected 6/29/94

Item	Test: 7		Source: Press Vent Stack	
	Run 0	Run 1	Run 2	Run 3
Log #	3252-52	3252-53	3252-54	3252-55
MDI (ug)*	< 1.2	326	301	209

* = Total Mass of MDI in the Sample in ug.

Reviewed By:

Gregg W. Holman

Gregg W. Holman

INTERPOLL LABORATORIES INC.

Phenol Result By EPA Method 8270
For Dept. 20/LP Dungannon, Collected 6/29/94

	Detection Limit	Test: 12		Source: Press Vent Stack
		Run 1	Run 2	Run 3
Log #		3252-36/37	3252-38/39	3252-40/41
Phenol*	840	< 840	< 840	< 840
Surrrogates				
2-Fluorophenol**		48.7	50.3	44.6
D6-Phenol**		31.1	27.5	24.9
2,4,6-Tribromophenol***		71.7	63.0	57.1

* = Total mass of the specified compound in the sample in ug.

** = Percent recovery of the field surrogate. (59800 ug 2-Fluorophenol and 5330 ug Phenol-D6 was added to the impinger solution before sampling.)

*** = Percent recovery of the lab surrogates.

Reviewed by:

Gregg W. Hol

Gregg W. Holman

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Sample Chain of Custody

Job LP/DUNGANNON Source THERMAL OIL HEATER Site STACK Log No. 3252
Field Engineer Date of Test 6-28-94 Test No. 1 No. of Runs

No. Items	Sample Type		Analysis		Sequence No.	Comments
4	**Probe Wash:** ☒Acetone ☐ MeCl$_2$	☐DI Water ☐	☒EPA M-5 ☐EPA M-29	☐EPA M-201A 3252 ☐	(01-04)P	
4	**Filter:** ☒4" Glass ☐ SS Thimble	☐Pallflex ☐2.5" Glass	☒EPA M-5 ☐EPA M-29 ☐EPA M-201A	☐EPA M-17	(01-04)F	
4 3	**Impingers:** ☒DI Water ☐3%H$_2$O$_2$ ☐1N NaOH ☐2,4-DNPH	☐H$_2$SO$_4$ ☐HNO$_3$/H$_2$O$_2$ ☐KMnO$_4$/H$_2$SO$_4$ ☒ MC 202	☐MN Protocol ☐WI Protocol ☒EPA M-202 ☐EPA M6,8 ☐Acid Gases	☐IA Protocol ☐Formaldehyde ☐EPA M-29 ☐EPA M-26 ☐	(01-04)I (02-04)I	
3	**Integrated Gas:** ☒Tedlar Bag	☐	☑EPA M-3 ☐	☐EPA M-10	(05,06,07)	
	Oxides of Nitrogen:		☐EPA M-7A ☐			
	Fuel Lab: ☐Fuel Sample	☐Aggregate	☐Per S-0163			
	Particle Sizing:		☐X-Ray Sdgraph ☐	☐Cascade Imp		
	Miscellaneous:	☐	☐			

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

Relinquished by/Affiliation	Accepted by/Affiliation	Date
		7/1/94 1500

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Sample Chain of Custody

Job L.P. / Dungannon, VA Source Dryer Site Stack Log No. 3252
Field Engineer m. Kachler Date of Test 6-26-94 Test No. 2 No. of Runs 3

No. Items	Sample Type		Analysis		Sequence No.	Comments
~~3+2~~	**Probe Wash:** ☐ Acetone ☒ MeCl$_2$	☐ DI Water ☐ ____	☐ EPA M-5 ☐ EPA M-29	☐ EPA M-201A ☒ 0011		Added to Impinger Rinse
—	**Filter:** ☐ 4" Glass ☐ SS Thimble	☐ Pallflex ☐ 2.5" Glass	☐ EPA M-5 ☐ EPA M-29 ☐ EPA M-201A	☐ EPA M-17		
3+2	**Impingers:** ☐ DI Water ☐ 3% H_2O_2 ☐ 1N NaOH ☒ 2,4-DNPH	☐ H_2SO_4 ☐ HNO_3/H_2O_2 ☐ $KMnO_4/H_2SO_4$ ☐ ____	☐ MN Protocol ☐ WI Protocol ☐ EPA M-202 ☐ EPA M6,8 ☐ Acid Gases	☐ IA Protocol 3252 ☒ Formaldehyde ☐ EPA M-29 ☐ EPA M-26 ☐ ____	(08 - 12)	
3	**Integrated Gas:** ☒ Tedlar Bag	☐ ____	☒ EPA M-3 ☐ ____	☐ EPA M-10	13,14,15	Bag #1 did not leak check before Run 1
—	**Oxides of Nitrogen:**		☐ EPA M-7A ☐ ____			
—	**Fuel Lab:** ☐ Fuel Sample	☐ Aggregate	☐ Per 5-0163			
—	**Particle Sizing:**		☐ X-Ray Sedigraph ☐ ____	☐ Cascade Imp		
—	**Miscellaneous:**	☐ ____	☐ ____			

Fuel Type:

Coal:	☐ Bituminous ☐ Anthracite ☐ Lignite	Wood:	☐ Wood Waste ☐ Dust ☐ Bark	[illegible]	☐ Waste Oil ☐ No. 2 ☐ No. 6
Misc:	☐ Natural Gas ☐ RDF ☐ ____				

Relinquished by/Affiliation	Accepted by/Affiliation	Date
Mark Kachler / Interpoll Labs		7/1/94 1500

033094-G:\STACK\WP\FORMS\S-278.2

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Sample Chain of Custody

Job CP/[illegible] Source Thermal Oil Heater Site Stack Log No. 3252
Field Engineer E Trowbridge Date of Test 6-29-94 Test No. 3 No. of Runs 3

No. Items	Sample Type		Analysis		Sequence No.	Comments
3	**Probe Wash:** ☒ Acetone ☐ MeCl$_2$	☐DI Water ☐	☐EPA M-5 ☐EPA M-29	☒EPA M-201A 3252 ☐	17-19 P	
4	**Filter:** ☐ 4" Glass ☐ SS Thimble	☐Pallflex ☒2.5" Glass	☐EPA M-5 ☐EPA M-29 ☒EPA M-201A	☐EPA M-17	(16-19) F	
3	**Impingers:** ☒DI Water ☐3%H$_2$O$_2$ ☐1N NaOH ☐2,4-DNPH	☐H$_2$SO$_4$ ☐HNO$_3$/H$_2$O$_2$ ☐KMnO$_4$/H$_2$SO$_4$ ☐	☐MN Protocol ☐WI Protocol ☐EPA M-202 ☐EPA M6,8 ☐Acid Gases	☐IA Protocol ☐Formaldehyde ☐EPA M-29 ☐EPA M-26 ☒ Virginia	(17-19) I	
3	**Integrated Gas:** ☒Tedlar Bag	☐	☒EPA M-3 ☐	☐EPA M-10	(20, 21, 22)	
	Oxides of Nitrogen:		☐EPA M-7A ☐			
	Fuel Lab: ☐Fuel Sample	☐Aggregate	☐Per S-0163			
	Particle Sizing:		☐X-Ray Sdgraph ☐	☐Cascade Imp		
	Miscellaneous:	☐	☐			

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

Relinquished by/Affiliation	Accepted by/Affiliation	Date
E Trowbridge / Interpoll		7/1/94 1500

033094-GASTACK\WP\FORMS\S-278.2

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Sample Chain of Custody

Job L.P. / Punganna
Field Engineer M. Koehler
Source Dryer
Date of Test 6-28-94
Site Stack
Test No. 6
Log No. 8252
No. of Runs 3

No. Items	Sample Type		Analysis		Sequence No.	Comments
3	**Probe Wash:** ☒ Acetone ☐ MeCl$_2$	☐ DI Water ☐ ________	☒ EPA M-5 ☐ EPA M-29	☐ EPA M-201A ☐ ________	(23-25)F	
3	**Filter:** ☒ 4" Glass ☐ SS Thimble	☐ Pallflex ☐ 2.5" Glass	☒ EPA M-5 ☐ EPA M-29 ☐ EPA M-201A	☐ EPA M-17	(23-25)F	
3 3	**Impingers:** ☒ DI Water ☐ 3% H$_2$O$_2$ ☐ 1N NaOH ☐ 2,4-DNPH	☐ H$_2$SO$_4$ ☐ HNO$_3$/H$_2$O$_2$ ☐ KMnO$_4$/H$_2$SO$_4$ ☐ ________	☐ MN Protocol ☐ WI Protocol ☒ EPA M-202 ☐ EPA M6,8 ☐ Acid Gases	☐ IA Protocol ☐ Formaldehyde ☐ EPA M-29 ☐ EPA M-26 ☐ ________	(23-25)I (23-25)I	
3	**Integrated Gas:** ☐ Tedlar Bag	☐ ________	☒ EPA M-3 ☐ ________	☐ EPA M-10	(26, 27, 28)	
—	**Oxides of Nitrogen:**		☐ EPA M-7A ☐ ________			
—	**Fuel Lab:** ☐ Fuel Sample	☐ Aggregate	☐ Per S-0163			
—	**Particle Sizing:**		☐ X-Ray Sdgraph ☐ ________	☐ Cascade Imp		
	Miscellaneous:	☐ ________	☐ ________			

Fuel Type:

Coal: ☐ Bituminous ☐ Anthracite ☐ Lignite

Wood: ☒ Wood Waste ☐ Dust ☐ Bark

Oil: ☐ Waste Oil ☐ No. 2 ☐ No. 6

Misc: ☐ Natural Gas ☐ RDF ☐ ________

Relinquished by/Affiliation	Accepted by/Affiliation	Date
Mark Koehler / Interpoll Labs		7/1/94 1500

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INTERPOLL LABORATORIES, INC.
(612) 786-6020

Sample Chain of Custody

Job LP/DUNGANNON Source PRESS VENT Site STACK Log No. 3752
Field Engineer E TROWBRIDGE Date of Test 6-25-94 Test No. 7 No. of Runs 3

No. Items	Sample Type		Analysis		Sequence No.	Comments
4	**Probe Wash:** ☐ Acetone ☒ MeCl$_2$	☐DI Water ☐	☐EPA M-5 ☐EPA M-29	☐EPA M-201A ☐ MDI NITRO		
1	**Filter:** ☐ 4" Glass ☐ SS Thimble	☐Pallflex ☒2.5" Glass	☐EPA M-5 ☐EPA M-29 ☐EPA M-201A	☐EPA M-17 MDI NITRO		
0	**Impingers:** ☐DI Water ☐3%H$_2$O$_2$ ☐1N NaOH ☐2,4-DNPH	☐H$_2$SO$_4$ ☐HNO$_3$/H$_2$O$_2$ ☐KMnO$_4$/H$_2$SO$_4$ ☐	☐MN Protocol ☐WI Protocol ☐EPA M-202 ☐EPA M6,8 ☐Acid Gases	☐IA Protocol ☐Formaldehyde ☐EPA M-29 ☐EPA M-26 ☐		
0	**Integrated Gas:** ☐Tedlar Bag	☐	☐EPA M-3 ☐	☐EPA M-10		
	Oxides of Nitrogen:		☐EPA M-7A ☐			
	Fuel Lab: ☐Fuel Sample	☐Aggregate	☐Per S-0163			
	Particle Sizing:		☐X-Ray Sdgraph ☐	☐Cascade Imp		
	Miscellaneous:	☐	☐			

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

Relinquished by/Affiliation	Accepted by/Affiliation	Date
E Trowbridge/Interpoll Labs		7/1/94 1500

033094-G:\STACK\WP\FORMS\S-278.2

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Sample Chain of Custody

Job L.P. / Dungannon, VA Source Press Vent Site Stack Log No. 3252
Field Engineer M. Buehler Date of Test 6-29-94 Test No. 6 No. of Runs 3

No. Items	Sample Type		Analysis		Sequence No.	Comments
3+1	**Probe Wash:** ☐ Acetone ☐ MeCl$_2$	Acetonitrile ~~☐DI Water~~ ☒ Toluene	☐EPA M-5 ☐EPA M-29	☐EPA M-201A ☒ 1-2 PP		
–	**Filter:** ☐ 4" Glass ☐ SS Thimble	☐Pallflex ☐2.5" Glass	☐EPA M-5 ☐EPA M-29 ☐EPA M-201A	☐EPA M-17		
3+1 3+1	**Impingers:** ☐DI Water ☐3%H$_2$O$_2$ ☐1N NaOH ☐2,4-DNPH	☐H$_2$SO$_4$ ☐HNO$_3$/H$_2$O$_2$ ☐KMnO$_4$/H$_2$SO$_4$ ☒ Toluene	☐MN Protocol ☐WI Protocol ☐EPA M-202 ☐EPA M6,8 ☐Acid Gases	☐IA Protocol ☐Formaldehyde ☐EPA M-29 ☐EPA M-26 ☐ ______		
~~2~~	**Integrated Gas:** ☐Tedlar Bag	☐ ______	~~☐EPA M-3~~ ☐ ______	☐EPA M-10		Ambient Air
–	**Oxides of Nitrogen:**		☐EPA M-7A ☐ ______			
–	**Fuel Lab:** ☐Fuel Sample	☐Aggregate	☐Per S-0163			
–	**Particle Sizing:**		☐X-Ray Sdgraph ☐ ______	☐Cascade Imp		
–	**Miscellaneous:**	☐ ______	☐ ______			

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

Relinquished by/Affiliation	Accepted by/Affiliation	Date
Mark Buehler / Interpoll Labs		7/1/94 1500

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Sample Chain of Custody

Job L.P./ [illegible] VA Source Press vent Site Stack Log No. 3252
Field Engineer M. Koehler Date of Test 6-27-94 Test No. 11 No. of Runs 3

No. Items	Sample Type		Analysis		Sequence No.	Comments
3	**Probe Wash:** ☐ Acetone ☒ MeCl$_2$	☐ DI Water ☐ ______	☐ EPA M-5 ☐ EPA M-29	☐ EPA M-201A ☐ ______		Added to Impinger catch
—	**Filter:** ☐ 4" Glass ☐ SS Thimble	☐ Pallflex ☐ 2.5" Glass	☐ EPA M-5 ☐ EPA M-29 ☐ EPA M-201A	☐ EPA M-17		
3	**Impingers:** ☐ DI Water ☐ 3% H$_2$O$_2$ ☐ 1N NaOH ☒ 2,4-DNPH	☐ H$_2$SO$_4$ ☐ HNO$_3$/H$_2$O$_2$ ☐ KMnO$_4$/H$_2$SO$_4$ ☐ ______	☐ MN Protocol ☐ WI Protocol ☐ EPA M-202 ☐ EPA M6,8 ☐ Acid Gases	☐ IA Protocol ☑ Formaldehyde ☐ EPA M-29 ☐ EPA M-26 ☐ ______		
—	**Integrated Gas:** ☐ Tedlar Bag	☐ ______	☐ EPA M-3 ☐ ______	☐ EPA M-10		Ambient Air
—	**Oxides of Nitrogen:**		☐ EPA M-7A ☐ ______			
—	**Fuel Lab:** ☐ Fuel Sample	☐ Aggregate	☐ Per S-0163			
—	**Particle Sizing:**		☐ X-Ray Sdgraph ☐ ______	☐ Cascade Imp		
—	**Miscellaneous:**	☐ ______	☐ ______			

Fuel Type: NA

Coal: ☐ Bituminous ☐ Anthracite ☐ Lignite

Wood: ☐ Wood Waste ☐ Dust ☐ Bark

Oil: ☐ Waste Oil ☐ No. 2 ☐ No. 6

Misc: ☐ Natural Gas ☐ RDF ☐ ______

Relinquished by/Affiliation	Accepted by/Affiliation	Date
Mark Koehler / Interpoll Labs		7/1/94 1520

033094-G:\STACK\WP\FORMS\S-278.2

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Sample Chain of Custody

Job L.P. / Dungannon
Field Engineer M. Buehler
Source Press vent
Date of Test 6-29-94
Site Stack
Test No. 12
Log No. 3252
No. of Runs 3

No. Items	Sample Type		Analysis		Sequence No.	Comments
–	**Probe Wash:** ☐ Acetone ☐ MeCl$_2$	☐DI Water ☐ ________	☐EPA M-5 ☐EPA M-29	☐EPA M-201A ☐ ________		
–	**Filter:** ☐ 4" Glass ☐ SS Thimble	☐Pallflex ☐2.5" Glass	☐EPA M-5 ☐EPA M-29 ☐EPA M-201A	☐EPA M-17		
3+1 3+1	**Impingers:** ☐DI Water ☐3%H$_2$O$_2$ ☐1N NaOH ☐2,4-DNPH	☐H$_2$SO$_4$ ☐HNO$_3$/H$_2$O$_2$ ☐KMnO$_4$/H$_2$SO$_4$ ☑ Chemicals A + B	☐MN Protocol ☐WI Protocol ☐EPA M-202 ☐EPA M6,8 ☐Acid Gases	☐IA Protocol ☐Formaldehyde ☐EPA M-29 ☐EPA M-26 ☐ ________		
–	**Integrated Gas:** ☐Tedlar Bag	☐ ________	☐EPA M-3 ☐ ________	☐EPA M-10		Ambient Air
–	**Oxides of Nitrogen:**		☐EPA M-7A ☐ ________			
–	**Fuel Lab:** ☐Fuel Sample	☐Aggregate	☐Per S-0163			
–	**Particle Sizing:**		☐X-Ray Sdgraph ☐ ________	☐Cascade Imp		
–	**Miscellaneous:**	☐ ________	☐ ________			

Fuel Type: NA

Coal: ☐Bituminous ☐Anthracite ☐Lignite

Wood: ☐Wood Waste ☐Dust ☐Bark

Oil: ☐Waste Oil ☐No. 2 ☐No. 6

Misc: ☐Natural Gas ☐RDF ☐ ________

Relinquished by/Affiliation	Accepted by/Affiliation	Date
Mark Buehler / Interpoll Labs		7/1/94 1500

033094-G:\STACK\WP\FORMS\S-278.2

Interpoll Laboratories
(612) 786-6020

IMPINGER CATCHES

Project Name: L.P. /Dungannon
Order Date:
Date Required: 6/24/94
Delivery Date: 6/24/94

Nature of Spiking Material	Spike Concentration	Spike Volume	Total Mass of Spike
D-6 Phenol (P-67)	5.3316 mg/mL	1.0 mL	5.3316 mg
2-fluorophenol (P-68)	49.8140 mg/mL	1.2 mL	59.7768 mg

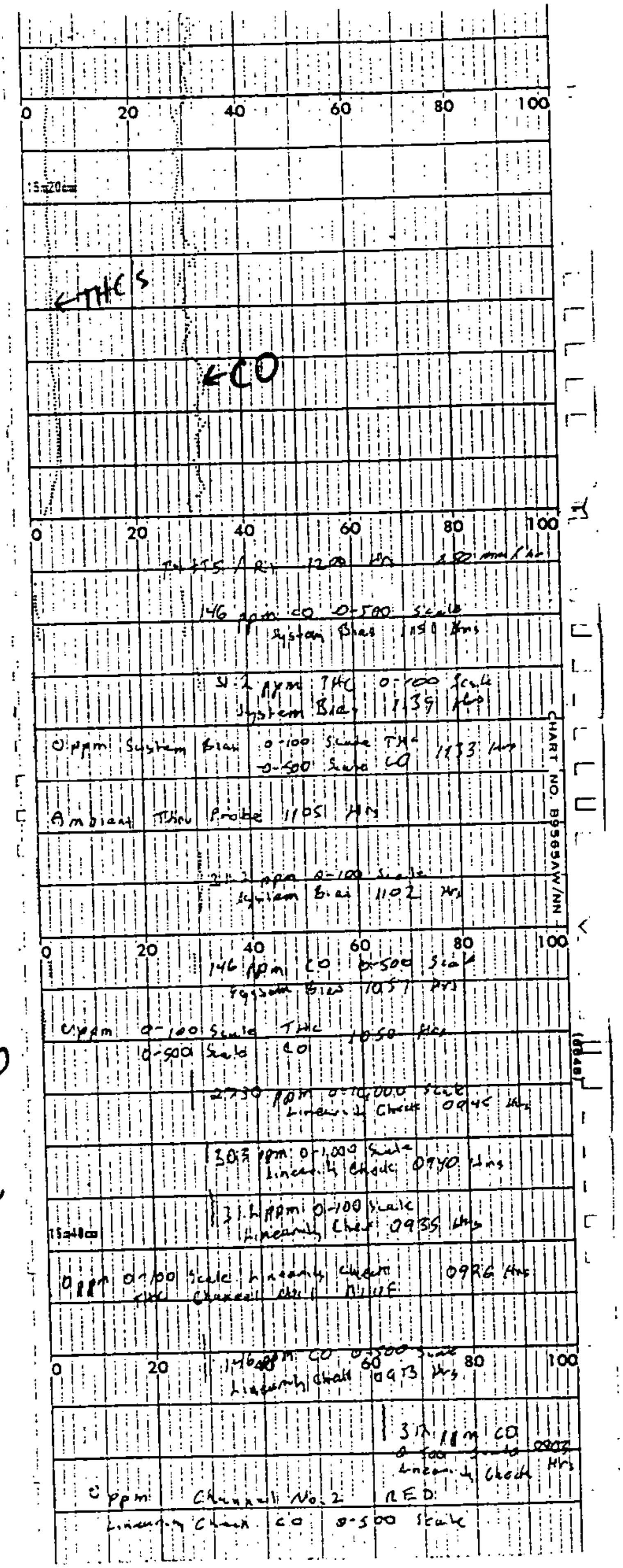
SPECIAL REQUIREMENTS

B. Drake 6-24-94

**Please return this form with the samples.

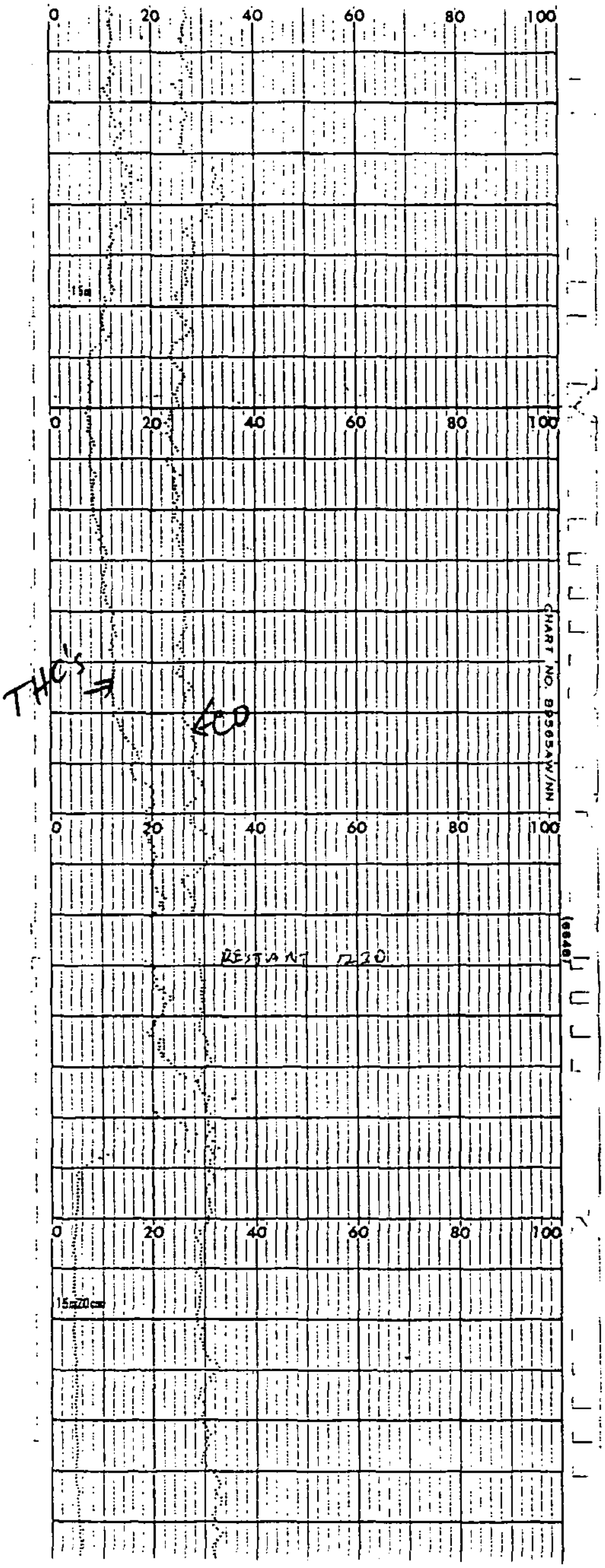
APPENDIX G

TOTAL HYDROCARBONS AND OXIDES OF NITROGEN STRIPCHARTS

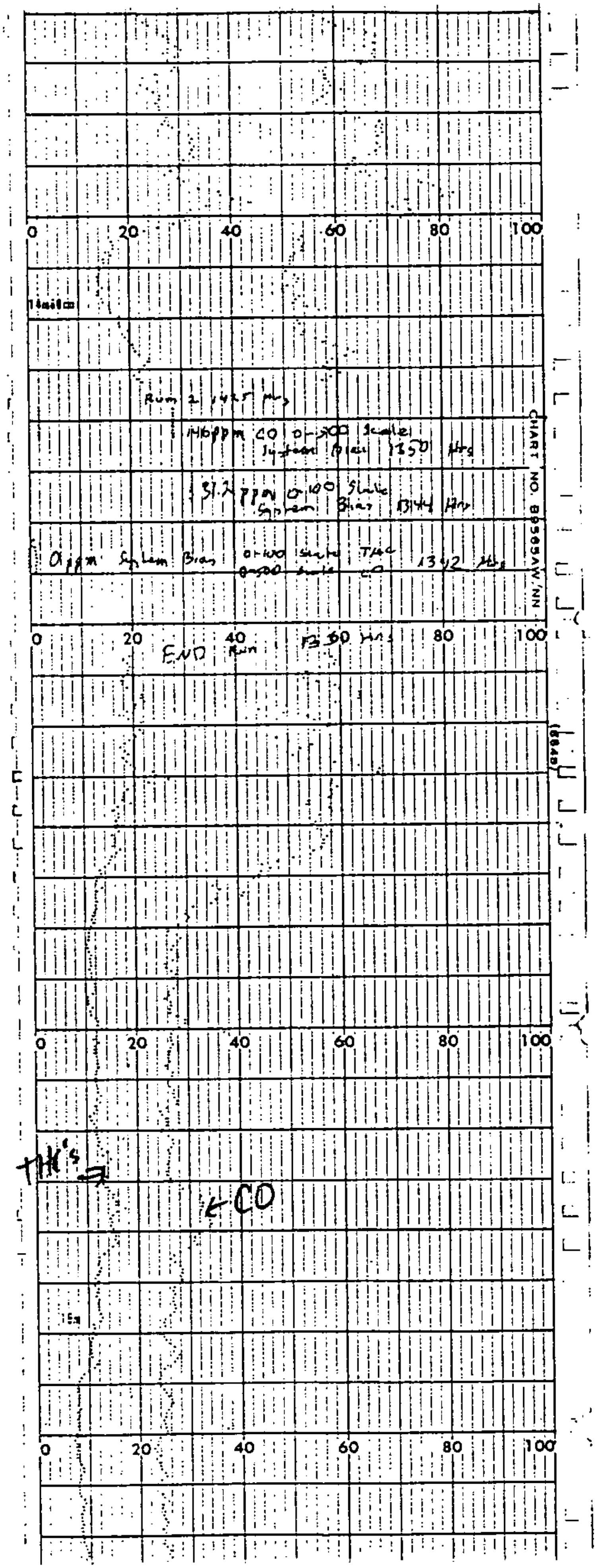


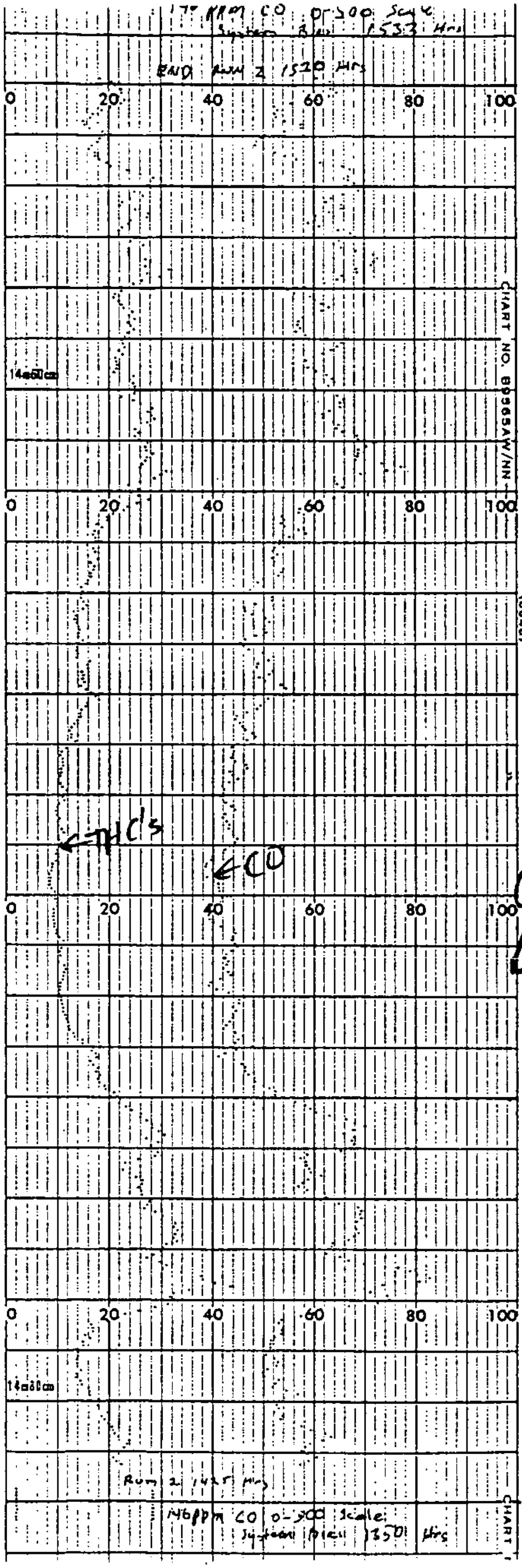
LP
Dungannon
THC's/CO
Dryer
Stack

Dryer

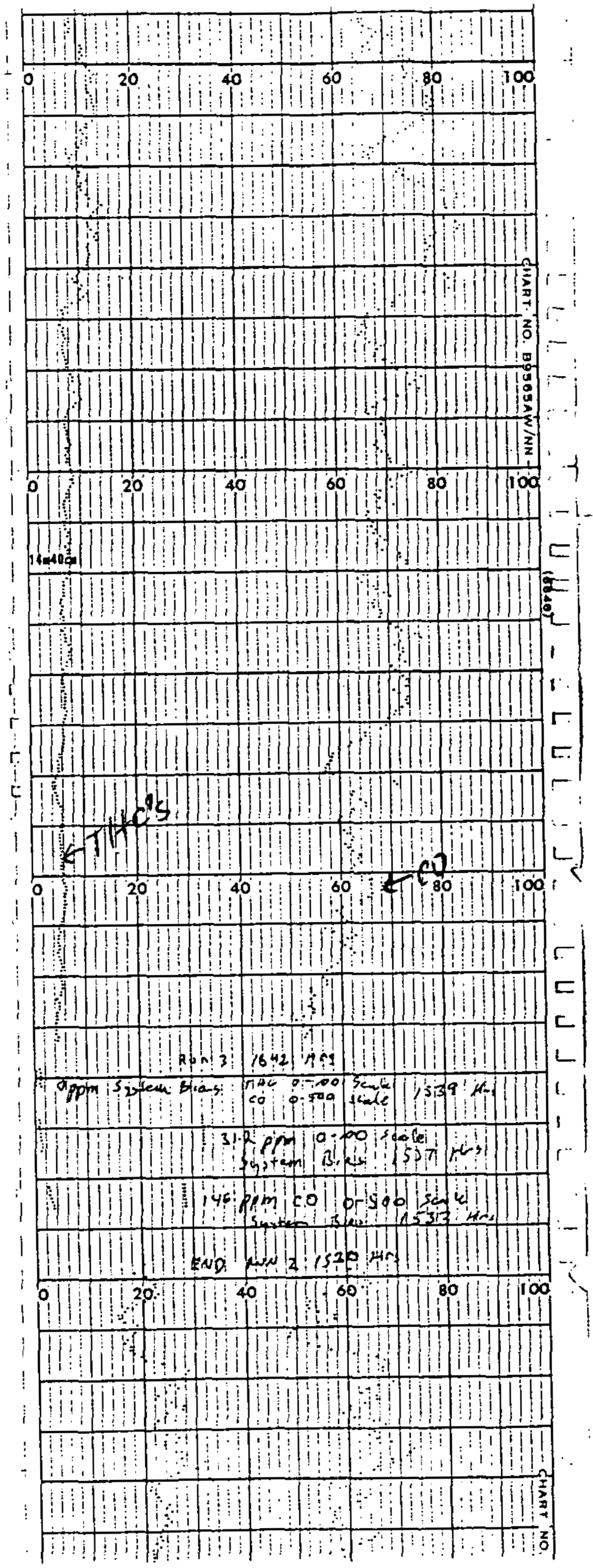

0
20
40
60
80
100
15m
THC's →
← CO
RESTART 1220
15m20cm
CHART NO. BP565AW/NN
(6846)

Dryer

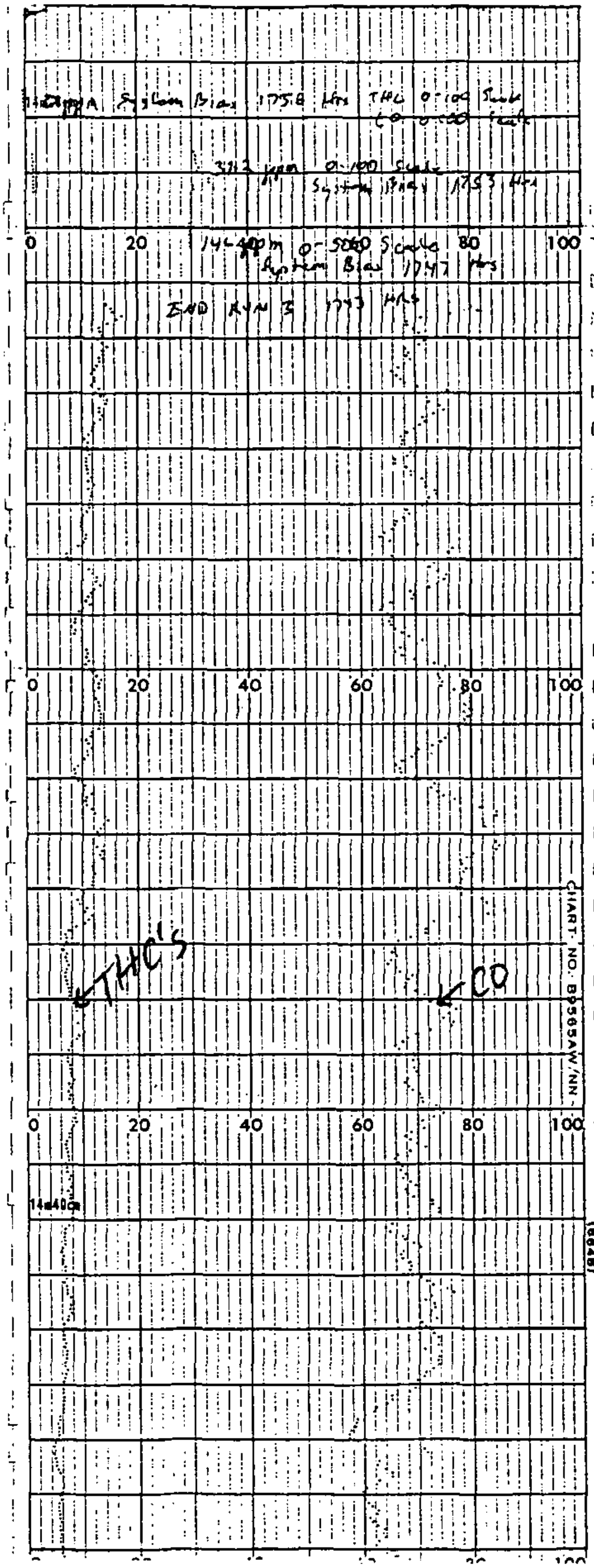

0
20
40
60
80
100
14mil/cm
Run 2 1425 Hrs
146ppm CO 0-200 Scale
System Bias 1350 Hrs
31.2 ppm 0-100 Scale
System Bias 1344 Hrs
0 ppm System Bias 0-100 Scale THC
0-500 Scale CO
1342 Hrs
CHART NO. B9565AW/NN
END Run 1530 Hrs
THC's
CO



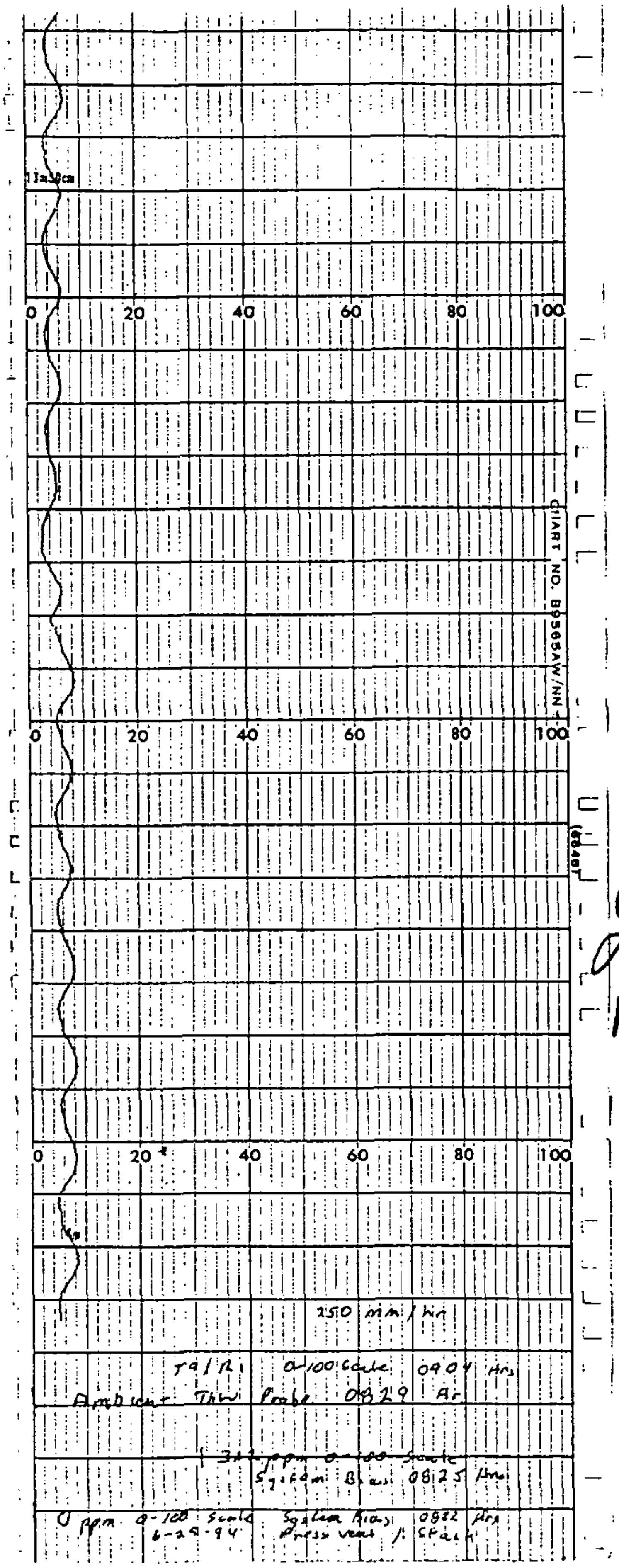
LP
Dungannon
THC's & CO
Dryer
Stack


0 20 40 60 80 100
CHART NO. B9565AW/NN
0 20 40 60 80 100
14m40cm
(6840)
←THC's
←CO
0 20 40 60 80 100
Run 3 1642 Hrs
0 ppm System Bias: THC 0-100 Scale CO 0-500 Scale 1539 Hrs
31.2 ppm 0-100 Scale System Bias 1537 Hrs
146 ppm CO 0-500 Scale System Bias 1533 Hrs
END RUN 2 1520 Hrs
0 20 40 60 80 100
CHART NO.

Dryer Stack



LP Dungannon THC's Dryer stack



250 mm/hr

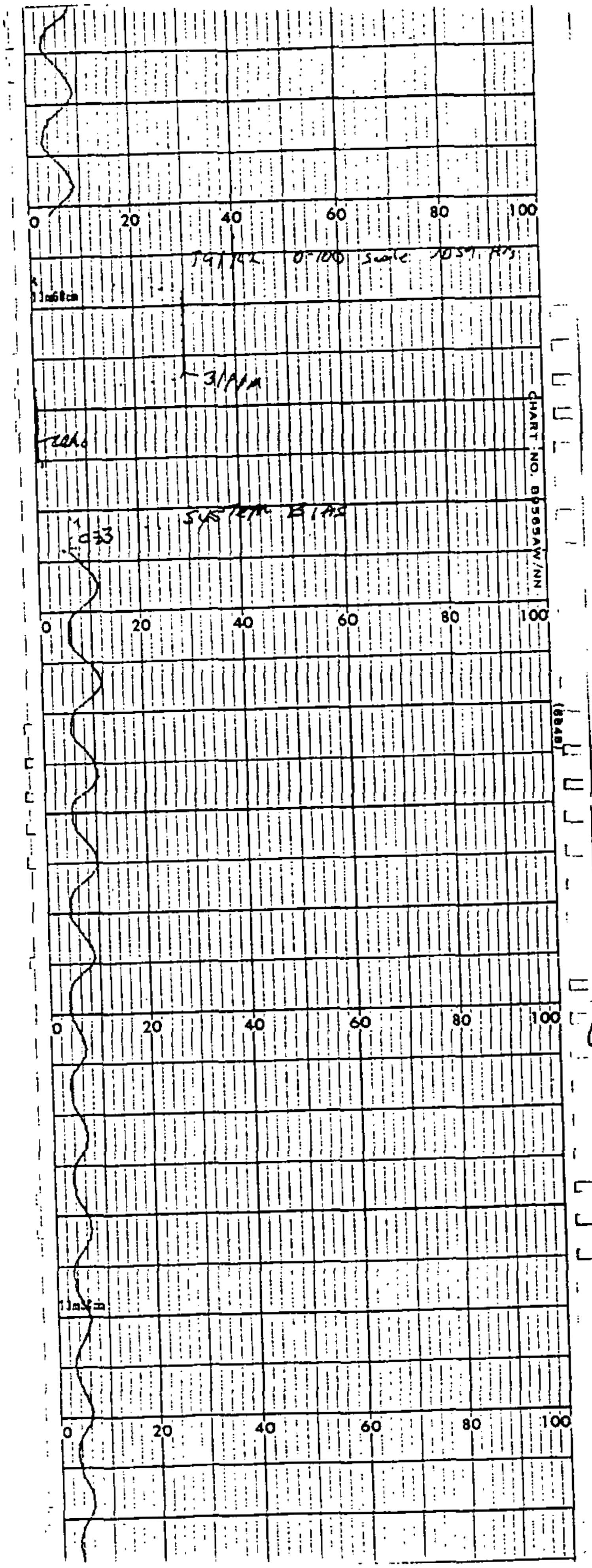
T4/R1 0-100 Scale 0904 Hrs

Ambient Thru Probe 0829 Hr

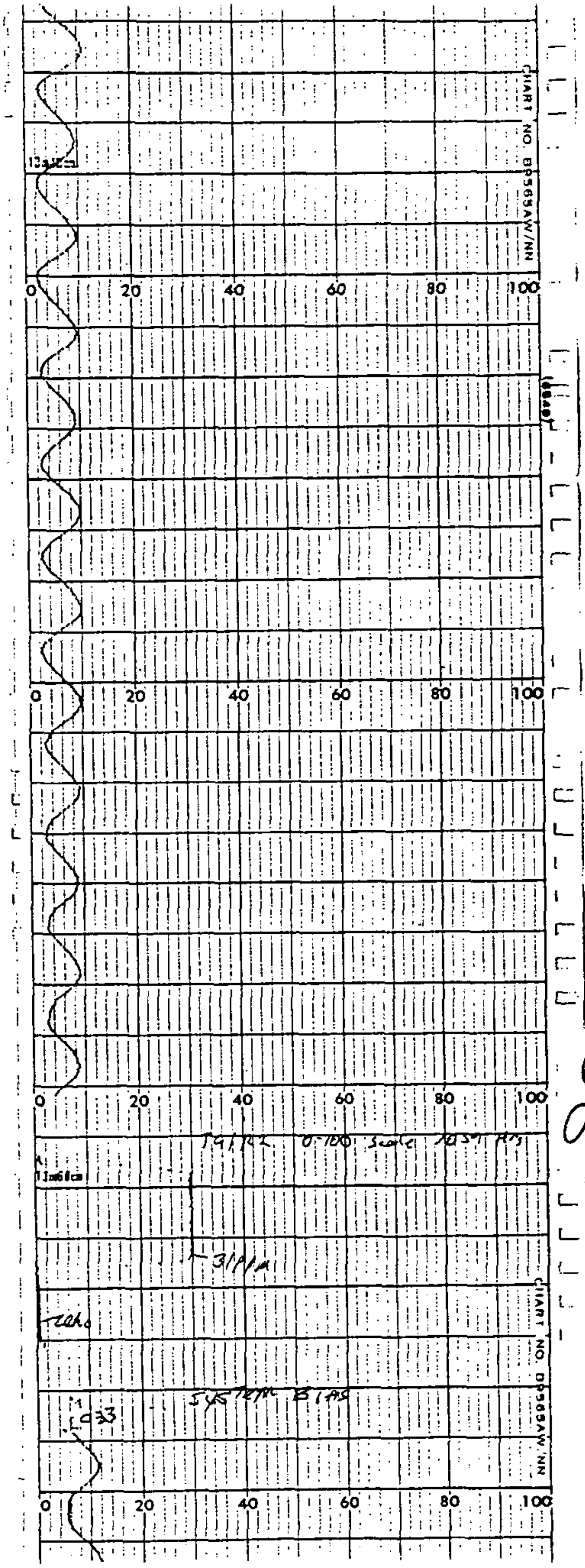
~~322 ppm 0-100 Scale~~
System Bias 0825 Hrs

0 ppm 0-100 Scale System Bias 0832 Hrs
6-29-94 Press Vent 1 Stack

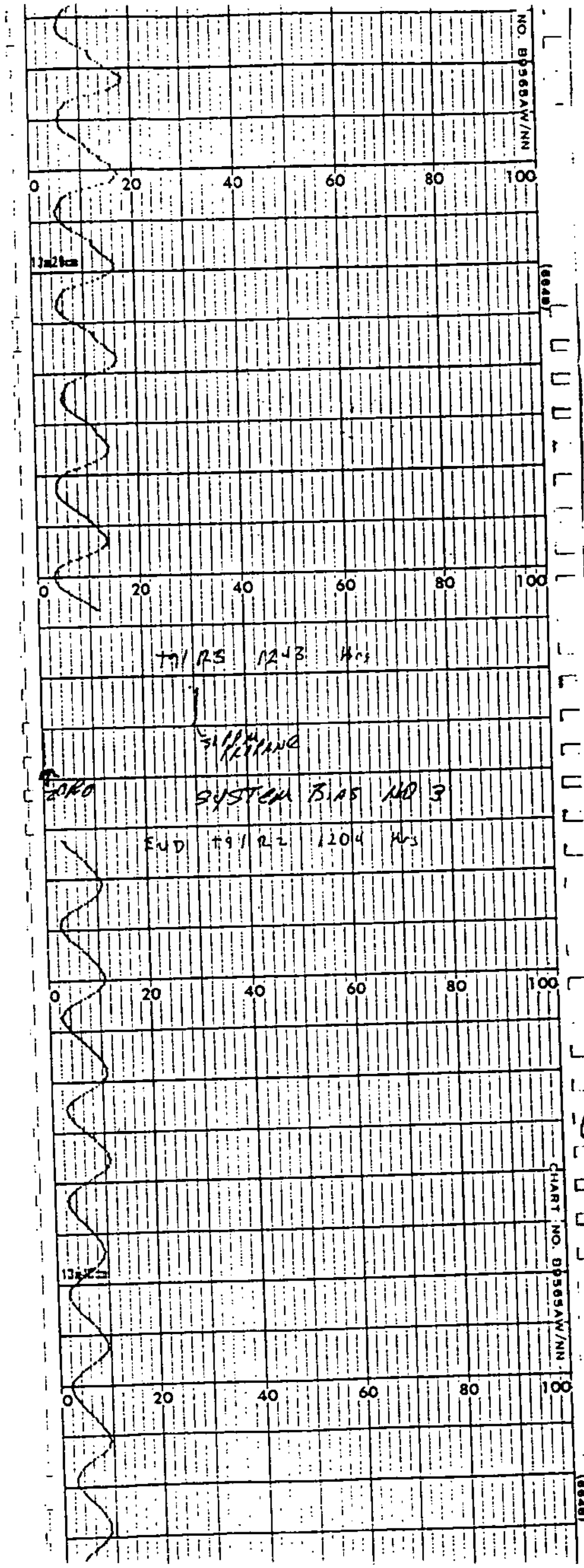
LP-
Dungannon
THC's
[redacted]
Press Vent
Stack



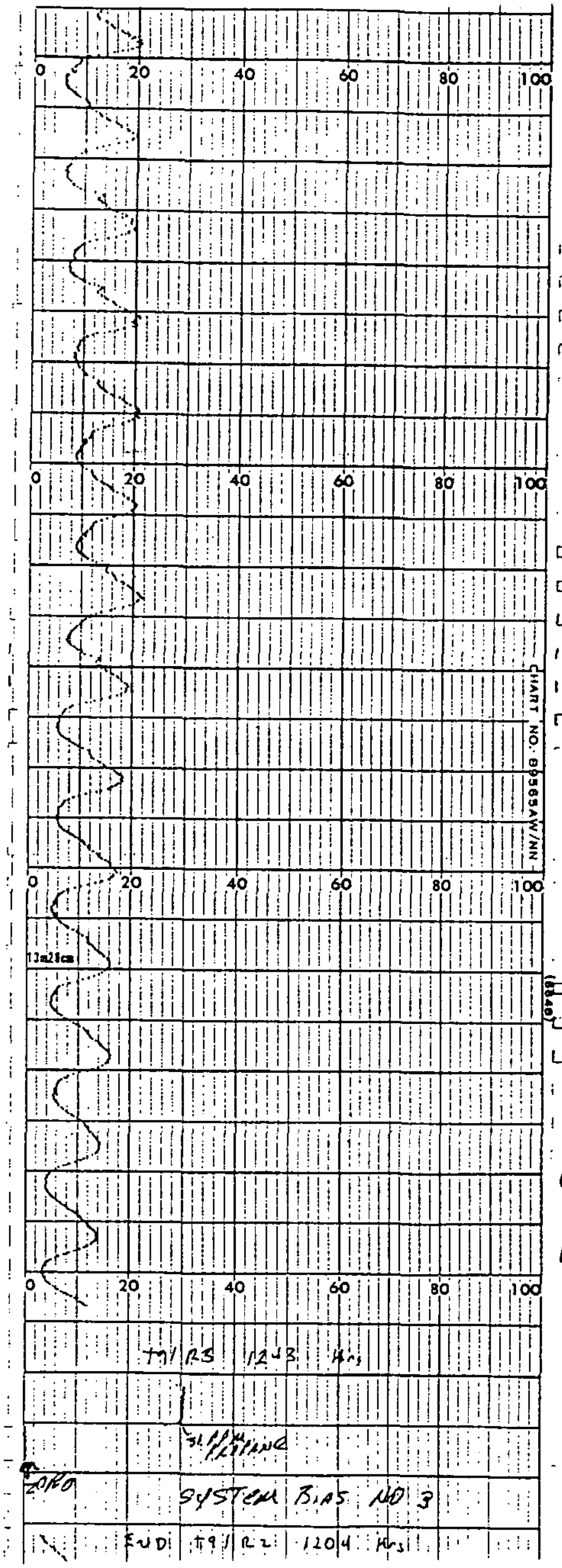
Up
Dungannon
THC's
Press
vent



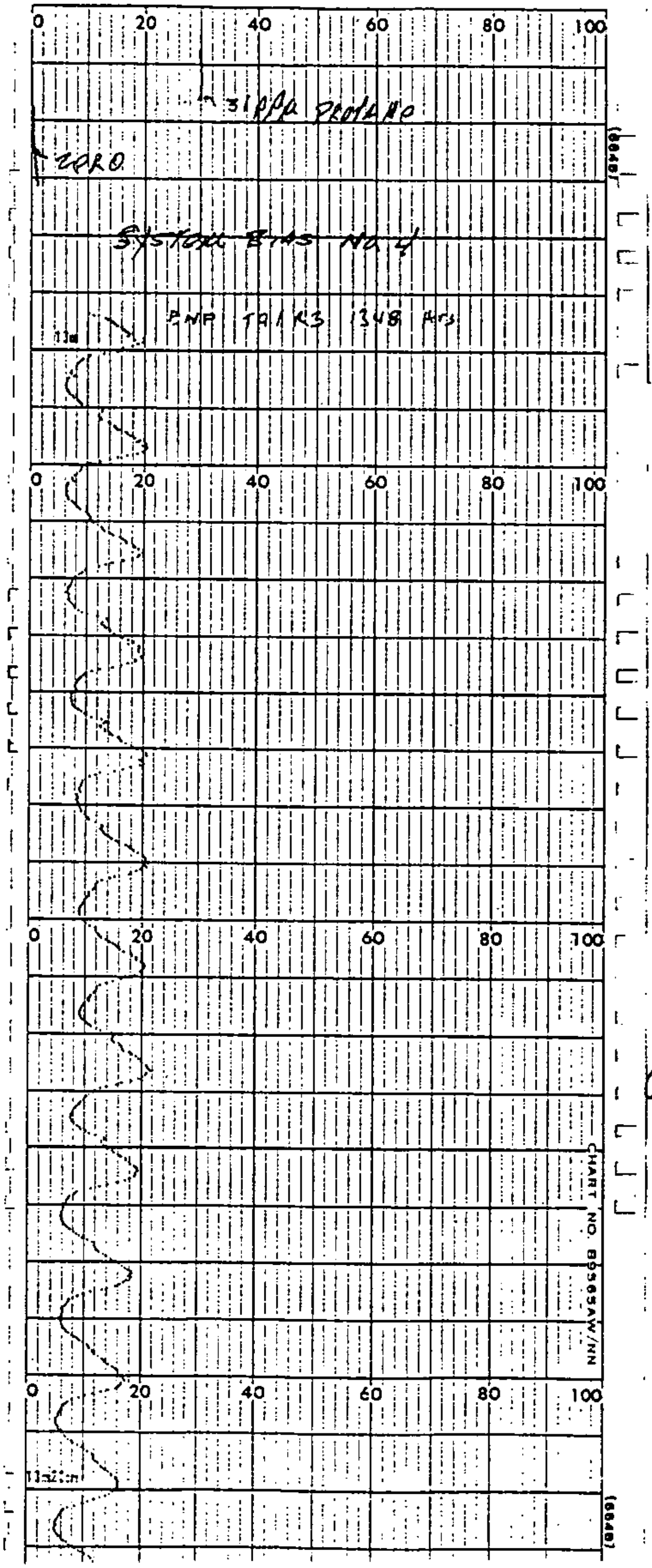
LP
Dungannon
THC's
Pres
vent



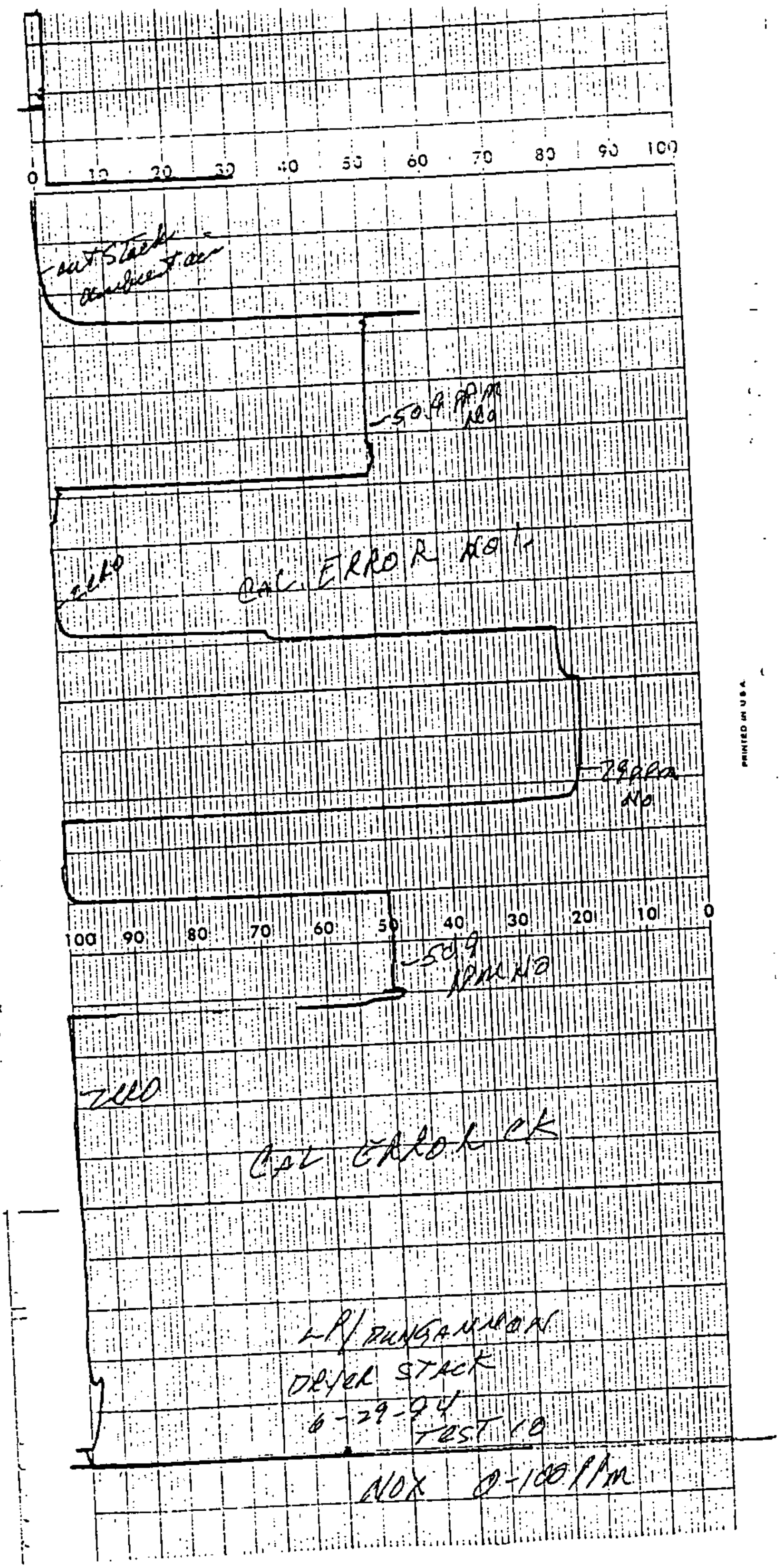
JP
Dungannon
THC's
Pressvent

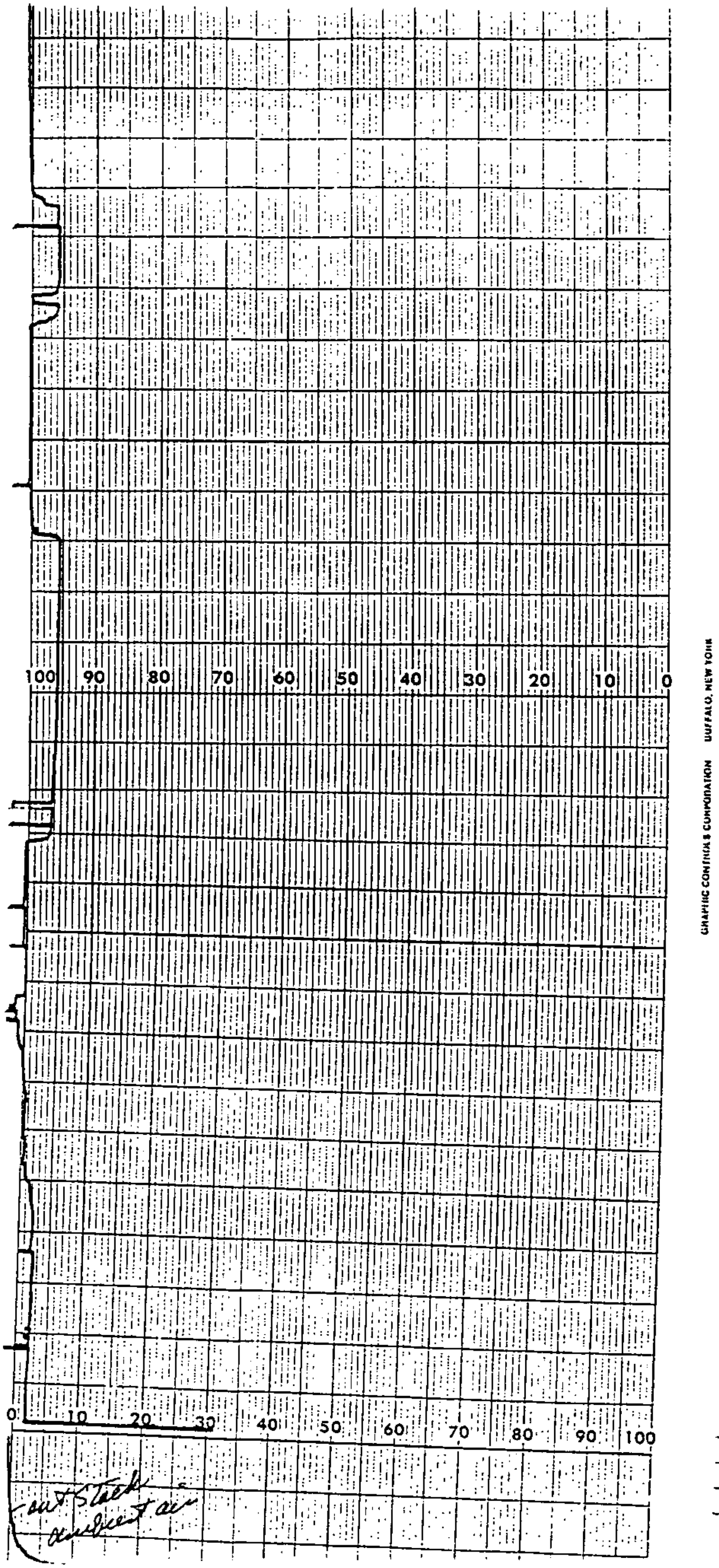


LP
Dungannon
THC's
Press
Vent



LP
Dungannon
THC's
Present


0
10
20
30
40
50
60
70
80
90
100
out Stack ambient air
50.9 PPM NO
zero
CAL ERROR NO
29 PPM NO
100
90
80
70
60
50
40
30
20
10
0
50.9 PPM NO
ZERO
CAL ERROR CK
LP/DUNGANNON
DRYER STACK
6-29-94
TEST 10
NOX 0-100 PPM
PRINTED IN U.S.A.


100
90
80
70
60
50
40
30
20
10
0
GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK
0
10
20
30
40
50
60
70
80
90
100
out Stack
ambient air

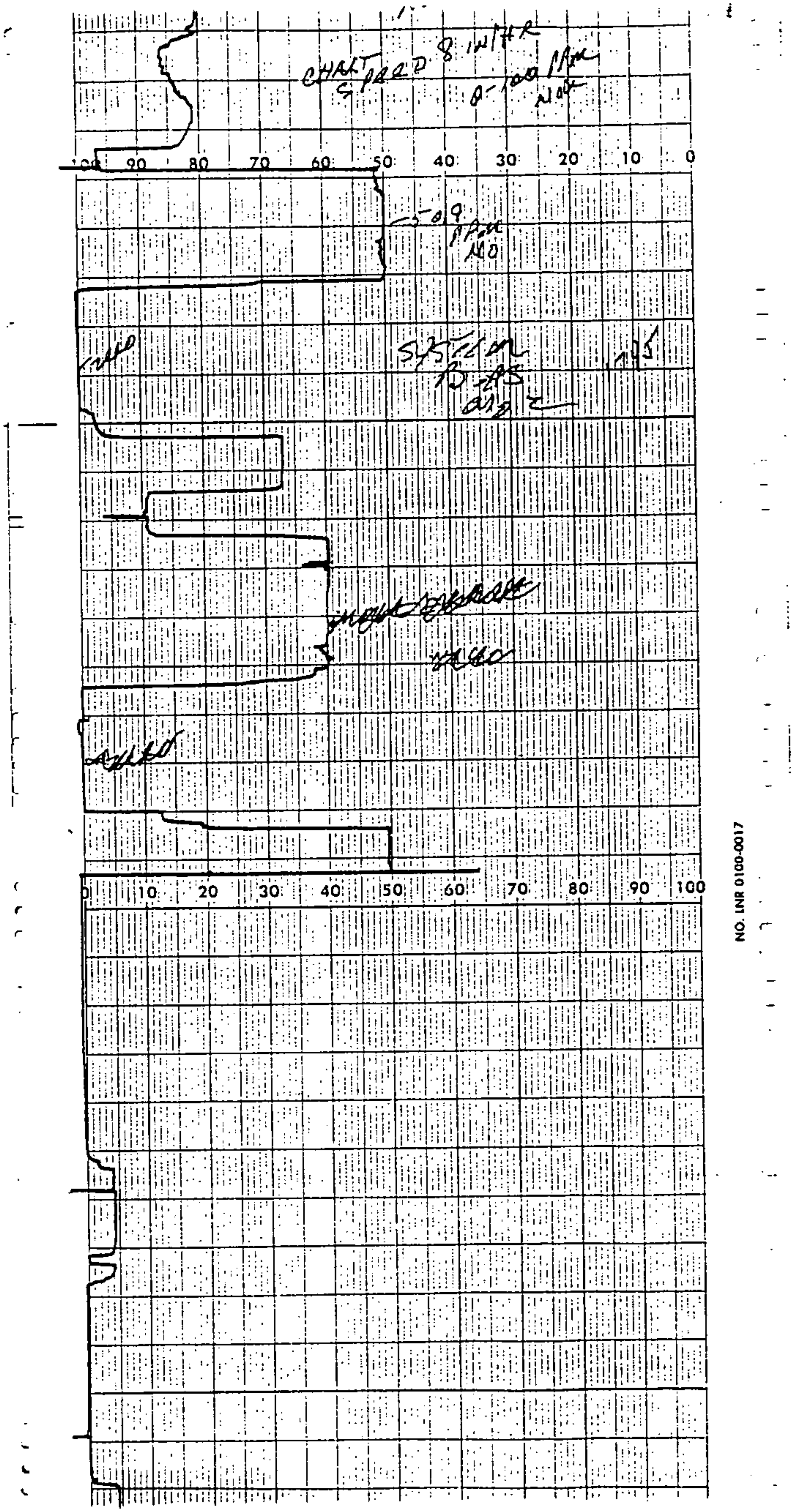
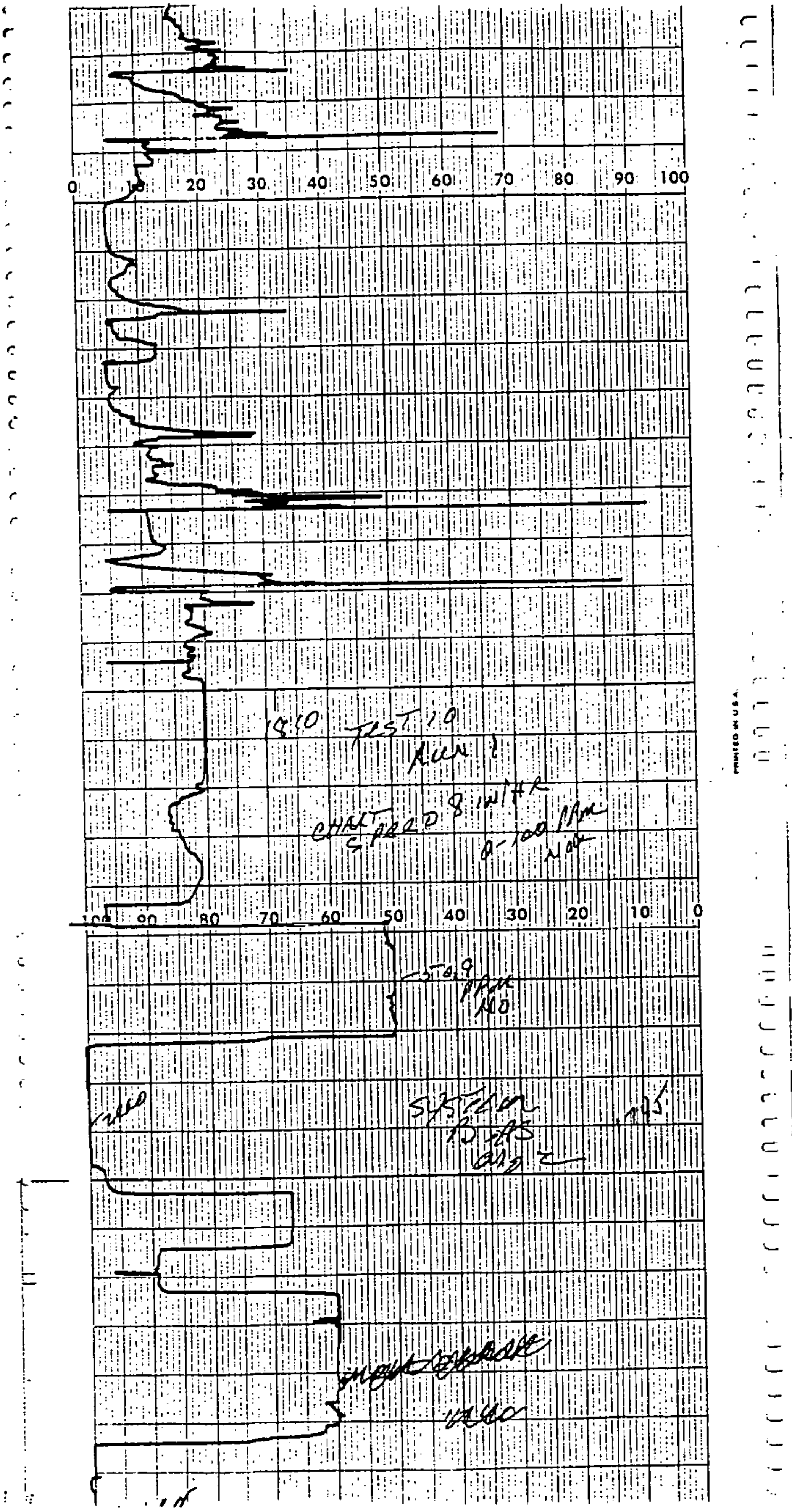


CHART SPEED 8 IN/HR
0-100 PPM NO
100
90
80
70
60
50
40
30
20
10
0
50.9 PPM NO
SYSTEM
0
10
20
30
40
50
60
70
80
90
100
NO. LNR 0100-0017



1810 TEST 10
RUN 2

CHART SPEED 8 IN/HR
0-100 PPM NOx

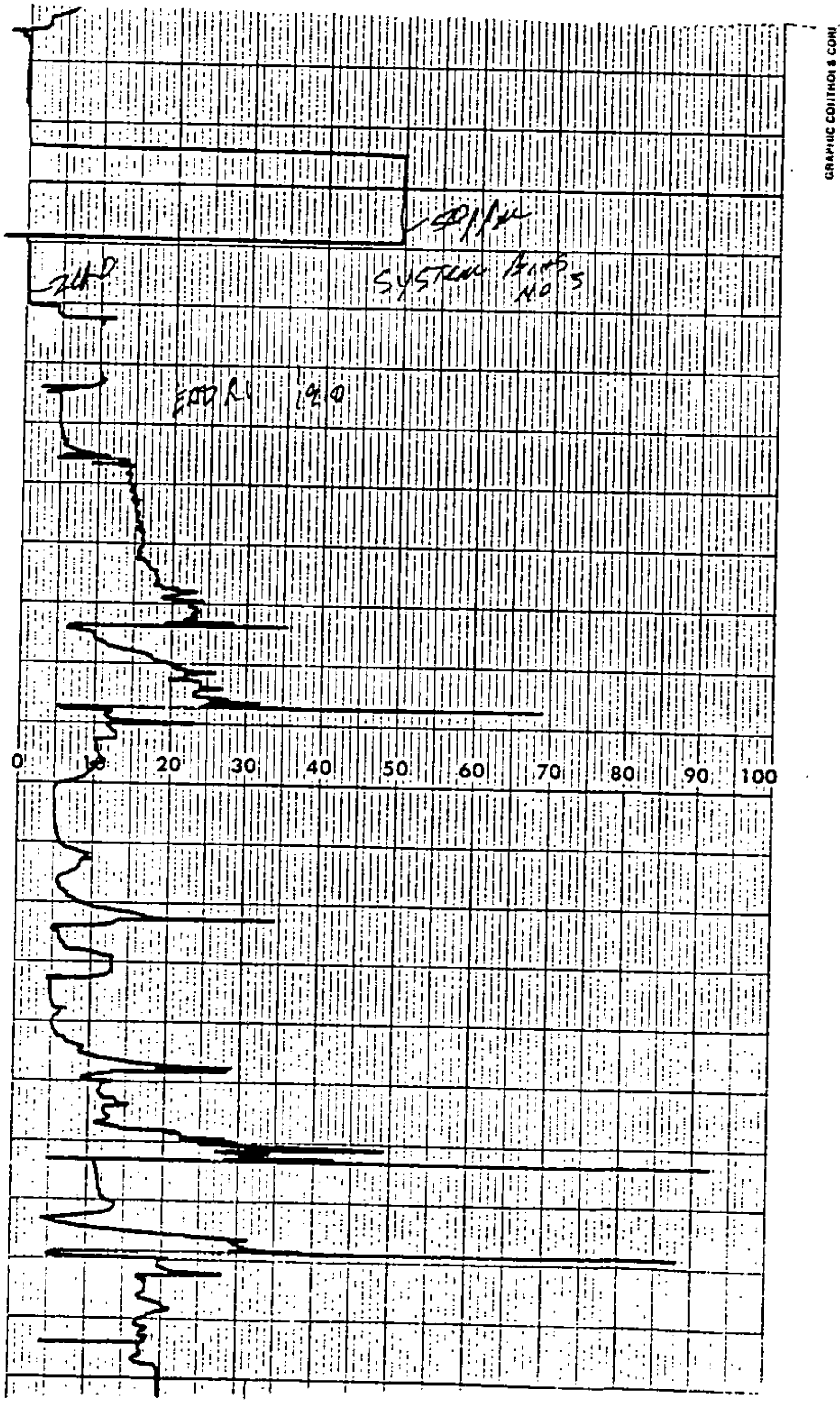
50.9 PPM NO

1220

SYSTEM [illegible]
[illegible]

1115

[illegible]


500/hr
240
SYSTEM A
NO 5
EDD RV 120
0
10
20
30
40
50
60
70
80
90
100
GRAPHIC CONTROLS CORP.

APPENDIX H

ANALYZER SPECIFICATIONS

SPECIFICATIONS FOR MODEL 10A
ROCK MOUNTED CHEMILUMINESCENT
NO-NO_x GAS ANALYZER

Sensitivity	Each instrument is equipped with the following ranges: 0 - 2.5 ppm 0 - 10 ppm 0 - 25 ppm 0 - 100 ppm 0 - 250 ppm 0 - 1000 ppm 0 - 2500 ppm 0 - 10000 ppm
Accuracy	Derived from the NO or NO_2 calibration gas, ±1% of fullscale
Response time (0-90%)	1.5 seconds - NO Mode
Typical	1.7 seconds - NO_x Mode
Output	0 - 10mV and 0 - 10V
Zero Drift	Negligible after 1/2-hour warm-up
Linearity	±1% of full scale
Input Power Requirements	115v/50Hz; 115v/60Hz

SPECIFICATIONS FOR ACS MODEL 3300 CO NDIR

Measuring principle	NDIR single beam method
Operating ranges	0 - 500 ppm 0 - 1000 ppm
Reproducibility	±0.5% of full scale
Stability	Zero drift; ±% of full scale/24H Span drift; ±% of full scale/24H
Noise	0.5% of full scale
Ambient temperature	-5 to 45^{0}C
Ambient humidity	Less than 90% RH
Response time (90% of final reading)	Electrical system; 2 sec, 3 sec, 5 sec (selectable with connector) Response of actual gas; Within 15 sec (depending on cell length)
Indicator	100 linear division
Output signal	OUTPUT 1; DC 0 - 1 V OUTPUT 2; DC 0 - 10 mV or DC 0 - 100 mV or DC 0 - 1 V or DC 4 - 20 mA (Allowable load resistance 500Ω max.)
Linearity	Better than ±2% of full scale (when linearizer is used)
Power supply	AC 115 V ± 10%, 60 Hz

Power consumption	Approx. 30 VA
Materials of gas-contacting parts	Measuring cell; SUS304 Window; CaF2 Piping; Polyethylene
Sample gas flow rate	1ℓ/min ± 0.5ℓ/min
Sample gas temperature	0 to 55°C
Purging gas flow rate	1ℓ/min (to be flowed as occasion demands)
Warmup time	Approx. 2 hours
External dimensions	200 x 250 x 541 (H x W x D) mm
Weight	Approx. 11 kg
Finish Color	MUNSELL N1.5

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

Ratfisch
INSTRUMENTE

TOTAL HYDROCARBON ANALYZER (FLAME IONIZATIO
Model RS 55

TECHNICAL DATES

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:

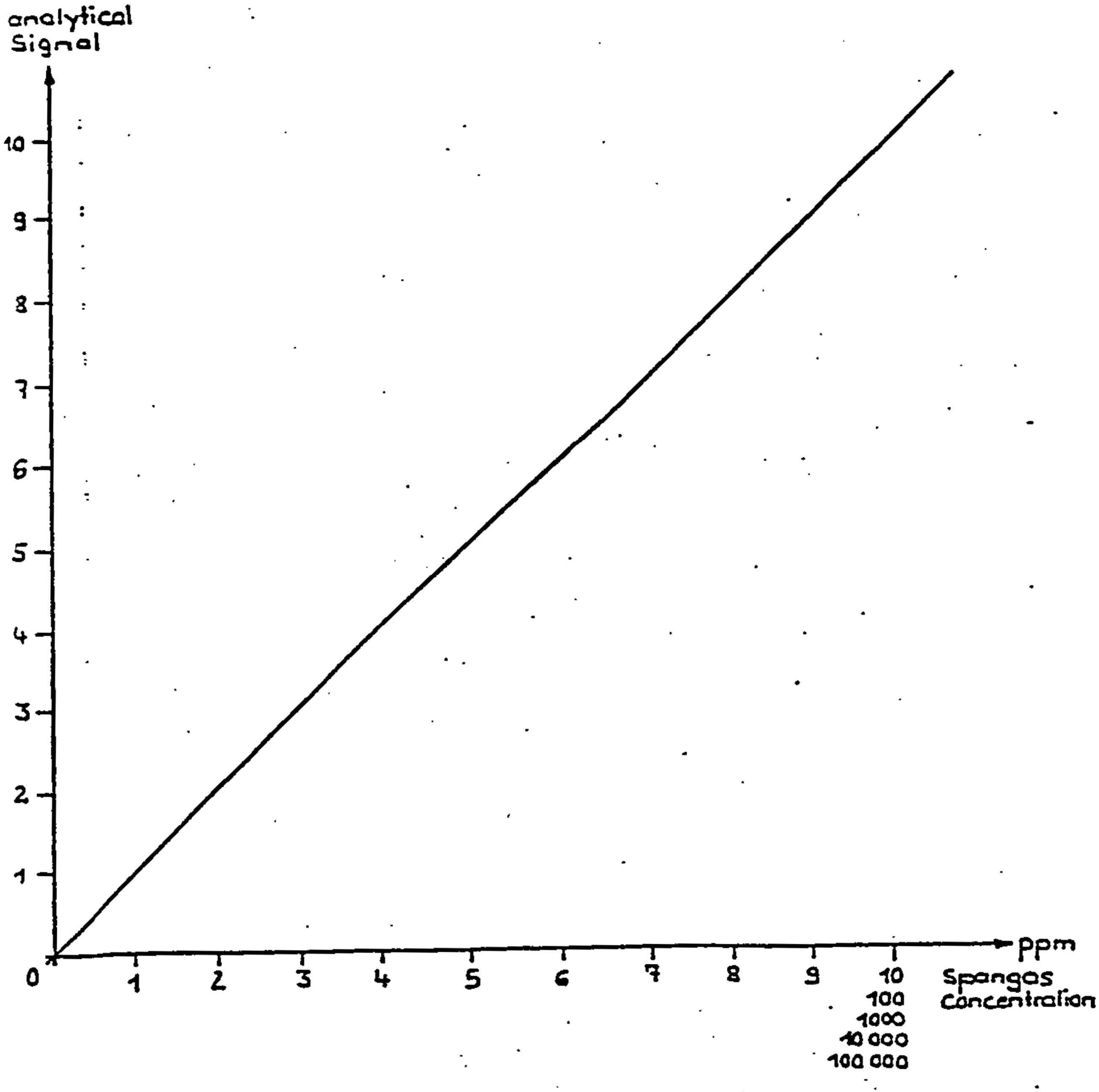
Temperature: ..160.°C

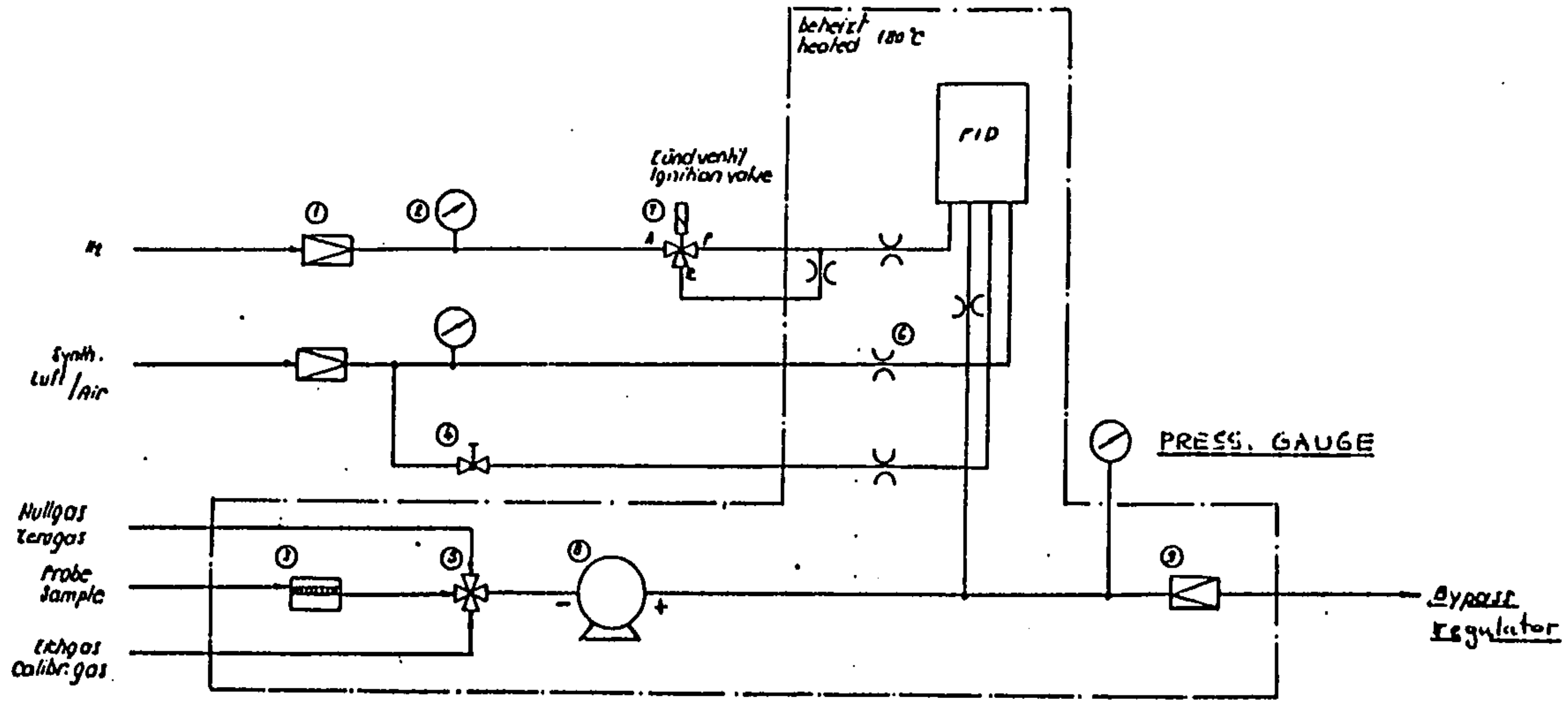
Zero Point : 3,90...
Gain : ....7,70...

Pressure Setting: Sample/Spangas/Zerogas: 200 mbar
Fuel: Hydrogen :.. ......0,35 bar
Combustion Air :.........0,80 bar

Span Gases : ..300. ppm C_1
24000. ppm C_1

CALIBRATION DIAGRAMM





1 Druckregler
Pressure regulator
2 Manometer
Gauge
3 Filter
4 Nadelventil
Needle valve
5 3 Wege ventil
3 way valve
6 Kapillare
capillary
7 Magnet ventil
solenoid valve
8 Pumpe
pump
9 Rückdruckregler
Back pressure regulator

Zündventil
Ignition valve

P-A angezogen
energised

R-A stromlos
at rest

Handumschaltung
manuel switching

Ratfisch
INSTRUMENTE

FLAMMEN IONISATIONS DETEKTOR
Flame Ionisation Detector

Fließplan
Flowdiagram

RS 55
13.04.88

APPENDIX I

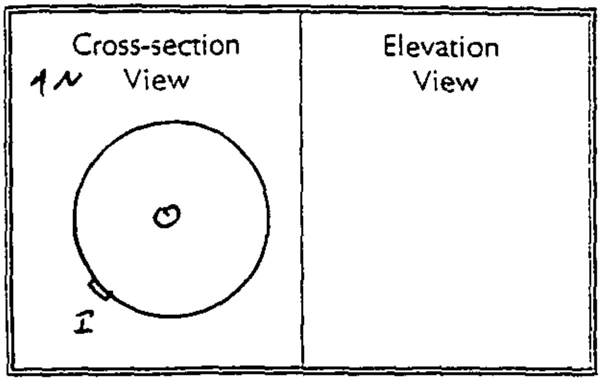
MEASUREMENT SYSTEMS PERFORMANCE SPECIFICATIONS

INTERPOLL LABORATORIES, INC.
(612) 786-6020

EPA Method 2 Field Data Sheet

Job L.P. / Dungannon, VA
Source Dryer / Stack
Test 4 Run 0 Date 6-28-94
Stack Dimen. 48 IN.
Dry Bulb 194 °F Wet bulb 130 °F
Manometer ☒ Reg. ☐ Exp ☐ Elec.
Barometric Pressure 28 72 IN.HG
Static Pressure +.72 IN.WC
Operators M. Koehler + D. Marsso
Pitot No. Inst C_p NA

Drawing of Test Site



Traverse Point No.	Fraction of Diameter	Distance From Stack Wall (IN.)	Distance From End of Port (IN.)	Velocity	Temp. of Gas (°F)
▨		Port Length: 6.0 IN.		Time Start: NA HRS	
I - 1	1/6	8.00	14.00		
2	3/6	24.00	30.00		
3	5/6	40.00	46.00		
Temp. Meas. Device & S/N: PDT-31 / TC				Time End: NA HRS	

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

INTERPOLL LABORATORIES, INC
(612) 786-6020

EPA Method 25 A
Calibration Error Check & Drift Determination

Job L.P. / Dungannon, VA

Test 4 Run 0 Date 6-28-94

Operator M. Kaehler

THC Calibration (Low Range): Time (HRS) 0926

*** BLUE	Cylinder Value (PPM)	Analyzer Response (PPM)	Difference (PPM)	Span Value (PPM)	Percent Of Span
Zero Gas	0	0	0	100	0
Low Level	31.2	31	.2	100	.2
Mid Level	303	307	4	1,000	.4
High Level	2750	2804	54	10,000	.54

THC Calibration (High Range): Time (HRS)

***	Cylinder Value (PPM)	Analyzer Response (PPM)	Difference (PPM)	Span Value (PPM)	Percent Of Span
Zero Gas	0				
Span					

O_2 Calibration: Time (HRS)

***	Cylinder Value (%)	Analyzer Response (%)	Difference (%)	Span Value (%)	Percent Of Span
Zero Gas	0				
Mid Level					
High Level					

CO_2 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.

121593-G:\STACK\WP\FORMS\S-420-14

INTERPOLL LABORATORIES, INC
(612) 786-6020

THC System Bias Check

Job L.P. / Dungannon, VA Source Dryer
Test 4 Run 1,2,3 Date 6-25-94 Site Stack
Operator M. Kaehler

Run	Time (HRS)	*** BLUE	Cylinder Value (PPM)	Analyzer Resp (PPM)		Diff. CE-SB (PPM)	Span Val. (PPM)	% of Span
				Cal. Err.	Sys. Bias			
1	1050	Zero Gas	0	0	0	0	100	0
		Upscale	31.2	31	31	0	100	0
2	1132	Zero Gas	0	0	0	0	100	0
		Upscale	31.2	31	31	0	100	0
3	1340	Zero Gas	0	0	1	1	100	1
		Upscale	31.2	31	32	1	100	1
4	1535	Zero Gas	0	0	1	1	100	1
		Upscale	31.2	31	32	1	100	1
5	1753	Zero Gas	0	0	0	0	100	0
		Upscale	31.2	31	31	0	100	0
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.

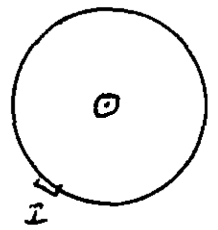
033194-G:\STACK\WP\FORMS\S-420-11

INTERPOLL LABORATORIES, INC.
(612) 786-6020

EPA Method 2 Field Data Sheet

Job L.P. / Dungannon, VA
Source Dryer / stack
Test 5 Run 0 Date 6-28-94
Stack Dimen. 48 IN.
Dry Bulb 194 °F Wet bulb 130 °F
Manometer ☒ Reg. ☐ Exp ☐ Elec.
Barometric Pressure 29.72 IN.HG
Static Pressure +.72 IN.WC
Operators M. Knebler & D. Marsso
Pitot No. INST C_p NA

Drawing of Test Site

Cross-section ↑N View	Elevation View
	

Traverse Point No.	Fraction of Diameter	Distance From Stack Wall (IN.)	Distance From End of Port (IN.)	Velocity	Temp. of Gas (°F)
		Port Length: 6.0 IN.		Time Start: NA HRS	
I-1	1/6	8.00	14.00		
2	3/6	24.00	30.00		
3	5/6	40.00	46.00		
Temp. Meas. Device & S/N: PDT-31 / TC				Time End: NA HRS	

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

INTERPOLL LABORATORIES, INC
(612) 786-6020

EPA Method 25 A
Calibration Error Check & Drift Determination

Job L.P. / Dragannon, VA
Test 5 Run 0 Date 6-28-94
Operator M. Koehler

THC Calibration (Low Range): Time (HRS)

***	Cylinder Value (PPM)	Analyzer Response (PPM)	Difference (PPM)	Span Value (PPM)	Percent Of Span
Zero Gas	0				
Low Level					
Mid Level					
High Level					

THC Calibration (High Range): Time (HRS)

***	Cylinder Value (PPM)	Analyzer Response (PPM)	Difference (PPM)	Span Value (PPM)	Percent Of Span
Zero Gas	0				
Span					

O_2 Calibration: Time (HRS)

***	Cylinder Value (%)	Analyzer Response (%)	Difference (%)	Span Value (%)	Percent Of Span
Zero Gas	0				
Mid Level					
High Level					

CO_x Calibration: RED Time: (HRS) 0859

*** RED	Cylinder Value (%)	Analyzer Response (%)	Difference (%)	Span Value (%)	Percent Of Span
Zero Gas	0	0	0	500	0
Mid Level	146	146	0	500	0
High Level	312	313	1	500	.2

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

INTERPOLL LABORATORIES, INC
(612) 786-6020

CO System Bias Check

Job L.P. / Dungannon, VA Source Dryer
Test 5 Run 1,2,3 Date 6-28-94 Site Stack
Operator M. Kaehler

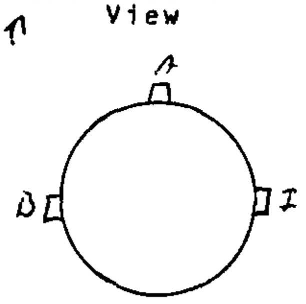
Run	Time (HRS)	*** RED	Cylinder Value (PPM)	Analyzer Resp (PPM)		Diff. CE-SB (PPM)	Span Val. (PPM)	% of Span
				Cal. Err.	Sys. Bias			
1	1050	Zero Gas	0	0	0	0	500	0
		Upscale	146	146	146	0	500	0
2	1132	Zero Gas	0	0	0	0	500	0
		Upscale	146	146	144	2	500	.4
3	1340	Zero Gas	0	0	-2	2	500	.4
		Upscale	146	146	142	4	500	.8
4	1533	Zero Gas	0	0	1	1	500	.2
		Upscale	146	146	143	3	500	.6
5	1746	Zero Gas	0	0	1	1	500	.2
		Upscale	146	146	149	3	500	.6
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.

INTERPOLL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job L.P. / Dungannon, VA
Source Press vent / Stack
Test 9 Run 0 Date 6-29-94
Stack dimen. 59.5 IN.
Dry bulb 100 °F Wet bulb 68 °F
Manometer: ☒ Reg. ☐ Exp. ☐ Elec.
Barometric pressure 28.62 in Hg
Static pressure -.63 in WC
Operators M. Kuehler + K. Rosenthal
Pitot No. INST C

Cross-section View



Elevation View

Drawing 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: 6.25 in.		Time start: NA hrs	
I - 1	1/6	9.92	16.17		
2	3/6	29.75	36.00		
3	5/6	49.58	55.83		
Temp. meas. device & S/N: PDT-31 / TC				Time end: NA hrs	

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

INTERPOLL LABORATORIES
EPA Method 25A
Calibration Error Check & Drift Determination

Job I.P. / Dungannon, VA

Test 9 Run . 0 Date 6-28-94

Operator M. Kuehler

THC Calibration (Low Range): Time(HRS) 0926

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0	0	0	100	0
Low level	31.2	31	.2	100	.2
Mid level	303	307	4	1,000	.4
High level	2750	2804	54	10,000	.54

THC Calibration (High Range): Time(HRS) ________

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

O_2 Calibration: Time(HRS) ________

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

CO_2 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

INTERPOLL LABORATORIES
(612) 786-6020

THC System Bias Check

Job L.P. / Dungannon, VA
Source Press Vent
Test 9 Run 1,2,3 Date 6-29-94
Site Stack
Operator mKaahler

Run	Time (HRS)	***	Cylinder Value (ppm)	Analyzer Resp (ppm)		Diff. CE-SB (ppm)	Span Val (PPM)	% of span
				Cal Err	Sys Bias			
1	0922	Zero gas	0	0	0	0	100	0
		Upscale	31.2	31	31	0	100	0
2	104[illegible].0	Zero gas	0	0	0	0	100	0
		Upscale	31.2	31	30	1	100	1
3	1210	Zero gas	0	0	0	0	100	0
		Upscale	31.2	31	31	0	100	0
4	1352	Zero gas	0	0	0	0	100	0
		Upscale	31.2	31	30	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, INC.
(612) 786-6020

EPA Method 2 Field Data Sheet

Job LP/Dungannon
Source Dryer Stack
Test 10 Run 1 Date 6-29-94
Stack Dimen. ________ IN.
Dry Bulb ________ °F Wet bulb ________ °F
Manometer ☒ Reg. ☐ Exp ☐ Elec.
Barometric Pressure 28.62 IN.HG
Static Pressure ________ IN.WC
Operators ________
Pitot No. C_p .840

Drawing of Test Site

Cross-section View	Elevation View

Traverse Point No.	Fraction of Diameter	Distance From Stack Wall (IN.)	Distance From End of Port (IN.)	Velocity	Temp. of Gas (°F)
▨		Port Length:	IN.	Time Start:	HRS
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
Temp. Meas. Device & S/N:				Time End:	HRS

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

032594-G:\STACK\WP\FORMS\S-392.

INTERPOLL LABORATORIES, INC
(612) 786-6020

NOX System Bias Check

Job LP/DUNGANNON Source Dryer
Test 10 Run 1 – Date 6-29-94 Site STACK
Operator

Run	Time (HRS)	***	Cylinder Value (PPM)	Analyzer Resp (PPM) Cal. Err.	Analyzer Resp (PPM) Sys. Bias	Diff. CE-SB (PPM)	Span Val. (PPM)	% of Span
1		Zero Gas	0	0	0	0	100	0
		Upscale	50.9	50	50	0	100	0
2	1745	Zero Gas	0	0	0	0	100	0
		Upscale	50.9	50	50	0	100	0
3	1815	Zero Gas	0	0	0	0	100	0
		Upscale	50.9	50	50	0	100	0
4		Zero Gas	0					
		Upscale						
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.

033194-G:\STACK\WP\FORMS\S-420-11

APPENDIX J

CALIBRATION GAS CERTIFICATION SHEETS

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

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

REFERENCE #: 88-26690 CYLINDER #:CC112056 CYL. PRESSURE:2000PSIG

EXPIRATION DATE: 9/15/96 LAST ANALYSIS DATE:9/15/93

CUSTOMER:TWIN CITY OXYGEN P.O.# 6422

METHOD: EPA PROTOCOL # 1 3.0.4. G-1

STANDARD:

SRM #:1667B

CYL #:CLM5046

CONC.:47.3PPM

INSTRUMENT:

COMPONENT: BECKMAN THC

MODEL #: 400

SERIAL #: 1003052

LAST CAL.: 9/1/93

COMPONENT: PROPANE
MEAN CONC: 31.2PPM

REPLICATE CONC.
DATE: 9/15/93 DATE:
31.3PPM
31.1PPM
31.3PPM

COMPONENT:
MEAN CONC:

REPLICATE CONC.
DATE: DATE:

COMPONENT:
MEAN CONC:

REPLICATE CONC.
DATE: DATE:

BALANCE GAS:AIR

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

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

REFERENCE #: 88-29870 CYLINDER #:CC98059 CYL. PRESSURE:2000PSIG
EXPIRATION DATE:3/8/97 LAST ANALYSIS DATE:3/8/94
CUSTOMER:TWIN CITY OXYGEN P.O.# 9082

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

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

COMPONENT:PROPANE		COMPONENT:		COMPONENT:	
MEAN CONC:303PPM		MEAN CONC:		MEAN CONC:	
REPLICATE CONC.		REPLICATE CONC.		REPLICATE CONC.	
DATE:3/8/94	DATE:	DATE:	DATE:	DATE:	DATE:
303PPM					
303PPM					
304PPM					

BALANCE GAS:AIR

REPLICATE DATA

DATE: 3/8/94					
Z	0	R	321.2	C	209.7
R	321.1	Z	0	C	209.7
Z	0	C	210.4	R	321.2

COMPONENT:PROPANE

DATE:		
Z	R	C
R	Z	C
Z	C	R

REPLICATE DATA

DATE:		
Z	R	C
R	Z	C
Z	C	R

COMPONENT:

DATE:		
Z	R	C
R	Z	C
Z	C	R

REPLICATE DATA

DATE:		
Z	R	C
R	Z	C
Z	C	R

COMPONENT:

DATE:		
Z	R	C
R	Z	C
Z	C	R

Z=ZERO C=CANDIDATE R=REFERENCE

ANALYST: Richard Sykes APPROVED BY:

"THIS REPORT STATED ACCURATELY THE RESULTS OF THE INVESTIGATION MADE UPON THE MATERIAL SUBMITTED TO THE ANALYTICAL LABORATORY. EVERY EFFORT HAS BEEN MADE TO DETERMINE OBJECTIVELY, THE INFORMATION REQUESTED; HOWEVER, IN CONNECTION WITH ITS RENDERING OF THIS REPORT, NATIONAL SPECIALTY GASES SHALL HAVE NO LIABILITY IN EXCESS OF ITS ESTABLISHED CHARGE FOR THE SERVICE."

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

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

REFERENCE #: 88-26688 CYLINDER #:CC117599 CYL. PRESSURE:2000PSIG

EXPIRATION DATE: 9/15/96 LAST ANALYSIS DATE:9/15/93

CUSTOMER:TWIN CITY OXYGEN P.O.# 6422
METHOD: EPA PROTOCOL # 1 3.0.4. G-1

STANDARD:

SRM #:2648A

CYL #:FF27174

CONC.:4892PPM

INSTRUMENT:

COMPONENT: BECKMAN THC

MODEL #: 400

SERIAL #: 1003052

LAST CAL.: 9/1/93

COMPONENT: PROPANE
MEAN CONC: 2750PPM

REPLICATE CONC.
DATE: 9/15/93 DATE:
2751PPM
2749PPM
2748PPM

COMPONENT:
MEAN CONC:

REPLICATE CONC.
DATE: DATE:

COMPONENT:
MEAN CONC:

REPLICATE CONC.
DATE: DATE:

BALANCE GAS:AIR

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

TO: TWIN CITY OXYGEN

CERTIFICATE OF ANALYSIS

DATE REPORTED:4/22/94 REFERENCE #:88-30855

MATERIAL SUBMITTED:CARBON MONOXIDE IN NITROGEN, CERTIFIED CYL. #CC16791

INFORMATION REQUESTED:RATIO ANALYSIS

METHOD OF ANALYSIS:INFRARED ANALYZER

RESULT OF INVESTIGATION:

COMPONENT	SPECIFICATION	CONCENTRATION
CO	150PPM	146PPM
N2		BALANCE

Richard Sykes
AUTHORIZED SIGNATURE

"THIS REPORT STATED ACCURATELY THE RESULTS OF THE INVESTIGATION MADE UPON THE MATERIAL SUBMITTED TO THE ANALYTICAL LABORATORY. EVERY EFFORT HAS BEEN MADE TO DETERMINE OBJECTIVELY, THE INFORMATION REQUESTED; HOWEVER, IN CONNECTION WITH ITS RENDERING OF THIS REPORT, NATIONAL SPECIALTY GASES SHALL HAVE NO LIABILITY IN EXCESS OF ITS ESTABLISHED CHARGE FOR THE SERVICE."

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

TO: TWIN CITY OXYGEN

CERTIFICATE OF ANALYSIS

DATE REPORTED: 4-20-93 REFERENCE #: 88-23715

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

INFORMATION REQUESTED: RATIO ANALYSIS

METHOD OF ANALYSIS: INFRARED

RESULT OF INVESTIGATION:

COMPONENT	SPECIFICATION	CONCENTRATION
CARBON MONOXIDE	300 PPM	312 PPM
NITROGEN		BALANCE

Richard Sykes
AUTHORIZED SIGNATURE

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

1290 COMBERMERE STREET, TROY, MICHIGAN 48084 (313) 589-2950

Shipped From : Scott Michigan
Our Project # : 538035
Your P.O. # : 40142
Expiration Date : 12-18-93
Cylinder Number : ALM013138
Cylinder Pressure 1900 psig
1 of 1 Component(s)

Customer :
GENEX
C/O AES BARBER POINT COAL
91-086 KAOMI LOOP
EWA BEACH HI 96707

\# # # # CERTIFICATE OF ANALYSIS - EPA PROTOCOL GASES # # # #
PERFORMED ACCORDING TO SECTION 3.0.4
Certified Per Traceability Procedure # G1
Protocol # 1
File # PO-3623
Certified Accuracy 1 % NBS Traceable

ANALYZED CYLINDER		REFERENCE STD			INSTRUMENTATION		
COMPONENT	CERTIFIED CONC.	SRM # (CRM #)	CYLINDER NUMBER	CONC.	INSTR/MODEL/SERIAL #	LAST CALIBRATION DATE	ANALYTICAL PRINCIPLE
NITRIC OXIDE	50.98 PPM	1684 2629A	ALM-013312 FF-28612	95.26 PPM 19.40 PPM	HORIBA OPE-235 483814	3-20-92	CHEMILUMINESCENCE

BALANCE GAS : NITROGEN

NITROGEN DIOXIDE 0.00 PPM (FROM SECOND ANALYSIS)

J-6

FIRST ANALYSIS DATE : 6-10-92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	REFERENCE GAS (mV)	RESULTS PPM
0.00	51.00	51.00	95.26 PPM	95.30	95.31
0.00	51.00	51.00		95.30	95.31
0.00	51.00	51.00		95.30	95.31

CALCULATED RESULTS 50.98
50.98
50.98

AVERAGE : 50.98 PPM

SECOND ANALYSIS DATE : 6-18-92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	REFERENCE GAS (mV)	RESULTS PPM
0.00	51.00	51.00	95.26 PPM	95.30	95.31
0.00	51.00	51.00		95.30	95.31
0.00	51.00	51.00		95.30	95.31
0.00	51.00 NOX	51.00			

CALCULATED RESULTS 50.98
50.98
50.98 50.98 PPM NOX

AVERAGE : 50.98 PPM

CALIBRATION CURVE 1 st DEGREE

SRM # (CRM #)	CONC. PPM	SPLIT PT (%)	DVM (mV)	FITTED VALUE	PERCENT ERROR
1684	95.26	100	95.30	95.31	0.05
2629A	19.40	20	19.40	19.40	0.01
	0.00	0	0.00	0.00	0.00
		0		0.00	0.00
		0		0.00	0.00
		0		0.0000	0.00
		0		0.00	0.00
2629A	19.40	LOW	19.40	19.40	0.01
1684	95.26	HIGH	95.25	95.26	-0.00

\# GMIS - GAS MA CTURER'S INTERNAL STANDARD

Analyst :

Approved By : L 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.

APPENDIX K

PROCESS RATE INFORMATION

Louisiana-Pacific Corporation
Northern Division
Rt. 8, Box 8263
Hayward, Wisconsin 54843
(715) 634-3454

LETTER OF TRANSMITTAL

DATE: 8/8/94	JOB NO.
ATTENTION:	Sheri Palcher
RE:	Dungannon June Test

TO Interpoll Laboratories
Circle Pines, MN 55014-1819

WE ARE SENDING YOU

☒ Attached ☐ Under separate cover via ______ the following items:

☐ Shop Drwgs. ☐ Prints ☐ Plans ☐ Samples ☐ Specifications

☐ Copy of Letter ☐ Change Order ☐ ______

COPIES	DATE	NO.	DESCRIPTION
1	06/28/94		Process Data (44 pages)

THESE ARE TRANSMITTED as checked below:

☐ For Approval
☒ For Your Use
☐ As Requested
☐ For Review & Comment
☐ FOR BIDS DUE ______ 199 .

☐ Approved As Submitted
☐ Approved As Noted
☐ *Returned For Corrections*
☐ Resubmit ____ copies for approval

☐ Submit ____ copies for distribution
☐ Return ____ corrected prints
☐ ______
☐ ______

REMARKS

Please send complete test report via next day service
ASAS

Copy To: FILE

Signed: S. M. Somers

K-1

DUNGANNON TESTING 6-28-94 THROUGH 6-29-94
PROCESS DATA

CONTENTS PAGE

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DRYER TESTING 6-28-94

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DRYER TESTING 6-29-94
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DUNGANNON TESTING 6-28-94 THROUGH 6-29-94
TEST SCHEDULE

THERMAL OIL HEATER TESTING 6-28-94

DATE	POLLUTANT	RUN #1	RUN #2	RUN #3
6-28	TSP	0830-0935	1005-1112	1137-1242
6-28	PM-10	1350-1512	1530-1646	1703-1818

DRYER TESTING 6-28-94

DATE	POLLUTANT	RUN #1	RUN #2	RUN #3
6-28	HCHO	0850-0951	1025-1127	1200-1303
6-28	CO,VOC	1230-1330	1426-1529	1641-1744
6-28	TSP	1426-1529	1641-1744	1813-1915

DRYER TESTING 6-29-94

DATE	POLLUTANT	RUN #1	RUN #2	RUN #3
6-29	NOx	1810-1910	2055-2155	2155-2255

PRESS VENT TESTING 6-29-94

DATE	POLLUTANT	RUN #1	RUN #2	RUN #3
6-29	MDI	0906-1009	1101-1204	1244-1347
6-29	VOC	0904-1033	1059-1204	1243-1348
6-29	HCHO	1547-1700	1719-1832	1848-2001
6-29	PHENOL	1547-1649	1719-1822	1827-1927

2

DUNGANNON TESTING 6-28-94 THROUGH 6-29-94
PROCESS DATA SUMMARY

Thermal Oil Heater testing 6-28, TSP
9.25 = Plant production rate in tons per hour
0.56 = Estimated Tons of dry fuel input based on temprature differential

Thermal Oil Heater testing 6-28, pm-10
9.53 = Plant production rate in tons per hour
0.55 = Estimated Tons of dry fuel input based on temprature differential

Dryer testing 6-28-94, formaldehyde
9.25 = Plant production rate in tons per hour
1.67 = Estimated Tons of dry fuel input based on temprature differential
22261 = Pound per hour of furnish produced by dryer
742 = average inlet temperature in degrees f.
42.2% = Moisture content of incoming wood
8.0% = Moisture content of wood afer drying

Dryer testing 6-28-94, TSP
9.56 = Plant production rate in tons per hour
1.92 = Estimated Tons of dry fuel input based on temprature differential
23016 = Pound per hour of furnish produced by dryer
838 = average inlet temperature in degrees f.
47.7% = Moisture content of incoming wood
7.5% = Moisture content of wood afer drying

Dryer testing 6-28-94, CO, VOC
9.59 = Plant production rate in tons per hour
1.83 = Estimated Tons of dry fuel input based on temprature differential
23077 = Pound per hour of furnish produced by dryer
804 = average inlet temperature in degrees f.
45.5% = Moisture content of incoming wood
7.0% = Moisture content of wood afer drying

Dryer testing 6-~~28~~29-94, NOx
9.34 = Plant production rate in tons per hour
1.77 = Estimated Tons of dry fuel input based on temprature differential
22473 = Pound per hour of furnish produced by dryer
930 = average inlet temperature in degrees f.
44.3% = Moisture content of incoming wood
7.8% = Moisture content of wood afer drying

Press vent testing 6-29, MDI and VOC
9.53 =Plant production rate in tons per hour
200 =MDI usage rate in lbs per hour
790 =Liquid Phenolic resin usage rate in pounds per hour (100% solids)
195 = Wax usage rate in pounds jper hour (100% solids)

Press vent testing 6-29, formaldehyde, phenol
9.61 =Plant production rate in tons per hour
200 =MDI usage rate in lbs per hour
790 =Liquid Phenolic resin usage rate in pounds per hour (100% solids)
194 = Wax usage rate in pounds jper hour (100% solids)

THERMAL OIL HEATER TESTING 6-28-94 TSP
DATA TIME: START= 08:30 END= 13:10 HOURS= 4.67

BOARD WEIGHTS - LBS

weights of approximately every 25th untrimmed board (from press tapes)

194	197
191	187
184	193
184	181
187	189
189	191
188	197
193	198
194	193
197	194

191.05 lb.=average untrimmed mat weight

174.05 lb.=average finished board weight (untrimmed mat weight-trim weight)

8.9% = TRIM

PLANT PRODUCTION RATE

4.67 =hours during testing
62 =pressloads
496 =no. of 8'x16' boards produced (pressloads x 8 boards per load)
86329 =lbs of finished product (boards produced x weight of finished board)
18499 =lbs of finished product per hour (lbs of finshed product / hours)

9.25 =tons of finished product per hour (lbs of finshed product per hour / 2000 lb)

FUEL BURNING RATE ESTIMATED BY BARK INPUT

8.11 =RIGHT SIDE FUEL CALIBRATION IN LB/COUNT
734 =RIGHT SIDE COUNTS DURING TESTING HOURS
5953 =RIGHT SIDE - LB. OF WET FUEL BURNED DURING TESTING

5.8 =LEFT SIDE FUEL CALIBRATION IN LB/COUNT
1052 =LEFT SIDE COUNTS DURING TESTING HOURS
6102 =LEFT SIDE - LB. OF WET FUEL BURNED DURING TESTING

4.67 =HOURS DURING TESTING
12055 =TOTAL LB. OF WET FUEL BURNED DURING TESTING
40.8% =AVERAGE MOISTURE CONTENT OF FUEL
7139 =TOTAL LB. OF DRY FUEL BURNED DURING TESTING (LB WET FUEL X (1- % MOISTURE)
1530 =LB. OF DRY FUEL BURNED PER HOUR (TOTAL LB OF DRY FUEL BURNED / TESTING HOURS
0.77 =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)
13.77 = ESTIMATED MMBTU INPUT PER HOUR (LB OF FUEL/HR x BTU CONTENT)

FUEL BURNING RATE ESTIMATED TEMPERATURE DIFFERENTIAL

515.1 = AVERAGE INCOMING OIL TEMPERATURE IN DEGREES f
536.3 = AVERAGE INCOMING OIL TEMPERATURE IN DEGREES f
65 = TEMPERATURE DIFFERENTIAL AT 100% CAPACITY IN DEG. F
21.3 = ACTUAL TEMPERATURE DIFFERENTIAL
31 = MAXIMUM BTU INPUT IN MM BTU/HR
10.1 = ESTIMATED MMBTU INPUT PER HOUR (ACTUAL TEMP. DIFF./ MAX. TEMP. DIFF. x MAX. HEAT INPUT)

9000 = ESTIMATED BTU CONTENT OF DRY FUEL (BTU / LB)
0.56 = 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

THERMAL OIL HEATER TESTING 6-28-94 PM-10
DATA TIME: START= 13:30 END= 18:30 HOURS= 5.00

BOARD WEIGHTS - LBS

weights of approximately every 25th untrimmed board (from press tapes)

192	189	190
195	206	191
190	193	
192	188	
190	197	
190	194	
195	195	
199	182	
196	184	
193	189	

192.27 lb.=average untrimmed mat weight

175.16 lb.=average finished board weight (untrimmed mat weight-trim weight)

8.9% = TRIM

PLANT PRODUCTION RATE

5.00 =hours during testing
68 =pressloads
544 =no. of 8'x16' boards produced (pressloads x 8 boards per load)
95287 =lbs of finished product (boards produced x weight of finished board)
19057 =lbs of finished product per hour (lbs of finshed product / hours)

9.53 =tons of finished product per hour (lbs of finshed product per hour / 2000 lb)

FUEL BURNING RATE ESTIMATED BY BARK INPUT

8.11 =RIGHT SIDE FUEL CALIBRATION IN LB/COUNT
860 =RIGHT SIDE COUNTS DURING TESTING HOURS
6975 =RIGHT SIDE - LB. OF WET FUEL BURNED DURING TESTING

5.6 =LEFT SIDE FUEL CALIBRATION IN LB/COUNT
1192 =LEFT SIDE COUNTS DURING TESTING HOURS
6675 =LEFT SIDE - LB. OF WET FUEL BURNED DURING TESTING

5.00 =HOURS DURING TESTING
13650 =TOTAL LB. OF WET FUEL BURNED DURING TESTING
40.3% =AVERAGE MOISTURE CONTENT OF FUEL
8149 =TOTAL LB. OF DRY FUEL BURNED DURING TESTING (LB WET FUEL X (1- % MOISTURE)
1630 =LB. OF DRY FUEL BURNED PER HOUR (TOTAL LB OF DRY FUEL BURNED / TESTING HOURS
0.82 =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)
14.67 = ESTIMATED MMBTU INPUT PER HOUR (LB OF FUEL/HR x BTU CONTENT)

FUEL BURNING RATE ESTIMATED TEMPERATURE DIFFERENTIAL

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

9000 = ESTIMATED BTU CONTENT OF DRY FUEL (BTU / LB)
0.55 = 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

DRYER TESTING 6-28-94 HCHO
DATA TIME: START= 08:30 END= 13:10 HOURS= 4.67

BOARD WEIGHTS - LBS

weights of approximately every 25th untrimmed board (from press tapes)

194
191
184
184
187
189
188
193
194
197
197
187
193
181
189
191
197
198
193
194

191.05 lb.=average untrimmed mat weight

174.05 lb.=average finished board weight (untrimmed mat weight-trim weight)

8.9% = TRIM

PLANT PRODUCTION RATE

4.67 =hours during testing
62 =pressloads
496 =no. of 8'x16' boards produced (pressloads x 8 boards per load)
86329 =lbs of finished product (boards produced x weight of finished board)
18499 =lbs of finished product per hour (lbs of finshed product / hours)
9.25 =tons of finished product per hour (lbs of finshed product per hour / 2000 lb)

DRYER PRODUCTION RATE:

22261 =lb of dryer production per hour (lb of finished product/(1-(%trim + %fines)
8.0% =%fines
8.9% =%trim
42.2% =moisture content of incoming wood
8.0% =moisture content of dried wood

742 =average inlet temerature

DRYER FUEL BURNING RATE

7.61 =fuel calibraton in lbs per count
2049 =total counts during testing
4.67 =hours during testing

15593 =total lbs. of fuel burned during testing (counts x calibration)
3341 =lbs of fuel burned per hour during testing (total lbs / hours)

1.67 =tons of fuel burned per hour during testing (lbs per hour / 2000 lbs)

8600 =estimated BTU content per lb of fuel
28.7 =estimated mmBTU input per hour (lbs of fuel per hour x BTU content)

DRYER TESTING 6-28-94 CO,VOC
DATA TIME: START= 12:20 END= 17:50 HOURS= 5.50

BOARD WEIGHTS - LBS

weights of approximately every 25th untrimmed board (from press tapes)

197	195	195
198	199	182
193	196	184
194	193	189
192	189	
195	206	
190	193	
192	188	
190	197	
190	194	

192.96 lb.=average untrimmed mat weight

175.79 lb.=average finished board weight (untrimmed mat weight-trim weight)

8.9% = TRIM

PLANT PRODUCTION RATE

5.50 =hours during testing
75 =pressloads
600 =no. of 8'x16' boards produced (pressloads x 8 boards per load)
105474 =lbs of finished product (boards produced x weight of finished board)
19177 =lbs of finished product per hour (lbs of finshed product / hours)
9.59 =tons of finished product per hour (lbs of finshed product per hour / 2000 lb)

DRYER PRODUCTION RATE:

23077 =lb of dryer production per hour (lb of finished product/(1-(%trim + %fines)
8.0% =%fines
8.9% =%trim
45.5% =moisture content of incoming wood
7.0% =moisture content of dried wood

804 =average inlet temerature

DRYER FUEL BURNING RATE

7.61 =fuel calibraton in lbs per count
2649 =total counts during testing
5.50 =hours during testing

20159 =total lbs. of fuel burned during testing (counts x calibration)
3665 =lbs of fuel burned per hour during testing (total lbs / hours)

1.83 =tons of fuel burned per hour during testing (lbs per hour / 2000 lbs)

8600 =estimated BTU content per lb of fuel
31.5 =estimated mmBTU input per hour (lbs of fuel per hour x BTU content)

DRYER TESTING 6-28-94 TSP
DATA TIME: START= 14:20 END= 19:20 HOURS= 5.00

BOARD WEIGHTS - LBS

weights of approximately every 25th untrimmed board (from press tapes)

190	197	199
190	194	189
195	195	191
199	182	
196	184	
193	189	
189	190	
206	191	
193	196	
188	202	

192.96 lb.=average untrimmed mat weight

175.79 lb.=average finished board weight (untrimmed mat weight-trim weight)

8.9% = TRIM

PLANT PRODUCTION RATE

5.00 =hours during testing
68 =pressloads
544 =no. of 8'x16' boards produced (pressloads x 8 boards per load)
95630 =lbs of finished product (boards produced x weight of finished board)
19126 =lbs of finished product per hour (lbs of finshed product / hours)
9.56 =tons of finished product per hour (lbs of finshed product per hour / 2000 lb)

DRYER PRODUCTION RATE:

23016 =lb of dryer production per hour (lb of finished product/(1-(%trim + %fines)
8.0% =%fines
8.9% =%trim
47.7% =moisture content of incoming wood
7.5% =moisture content of dried wood

838 =average inlet temerature

DRYER FUEL BURNING RATE

7.61 =fuel calibraton in lbs per count
2528 =total counts during testing
5.00 =hours during testing

19238 =total lbs. of fuel burned during testing (counts x calibration)
3848 =lbs of fuel burned per hour during testing (total lbs / hours)

1.92 =tons of fuel burned per hour during testing (lbs per hour / 2000 lbs)

8600 =estimated BTU content per lb of fuel
33.1 =estimated mmBTU input per hour (lbs of fuel per hour x BTU content)

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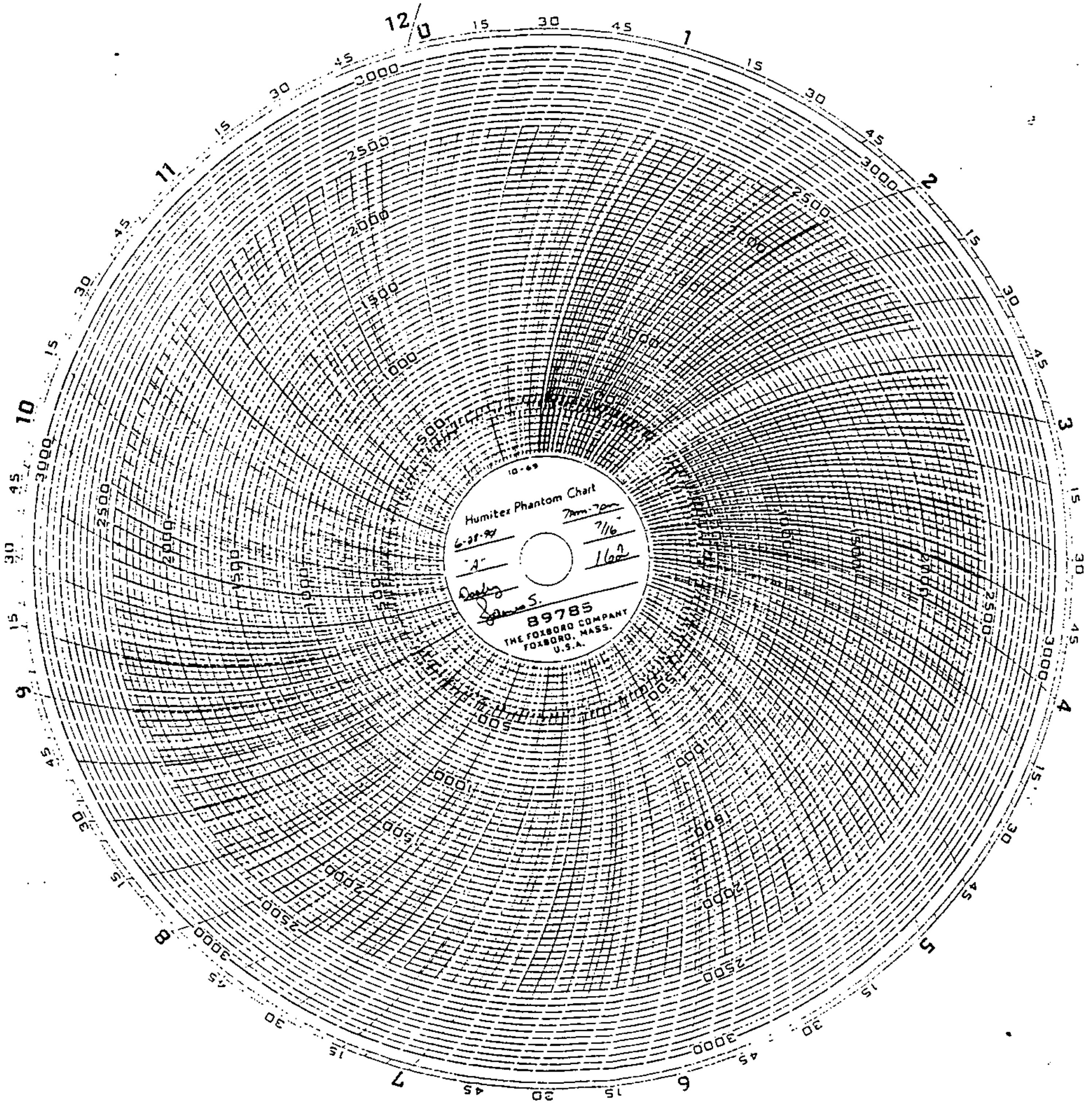
PRESS CHART
6-28-94
0700 - 1900



OUISIANA-PACIFIC CORPORATION
DUNGANNON, VIRGINIA

PRESS REPORT

PERATOR James S.
SHIFT 7Am - 7pm
CREW "A"
DATE 6-28-94

Th KNESS: 7/16"
PRESS LOADS 162 - 193,541
BLENDER SHUTDOWNS CORE 21

VERALL TIMER:
DECOMPRESSION TIME
SURFACE 17

PRESS TEMP: 400°

LINE SPEED	FROM	TO
31	7:00	7:00

	CORE RESIN	SURFACE RESIN
BEGIN	1519002	6354819
END	1521047	6363677

Cleaned Blender Shrouds & Tracks

Former hydraulic and radiater blown out

FCOS hydraulic unit and radiater blown out

Blender outfeed conv. tail pulleys cleaned

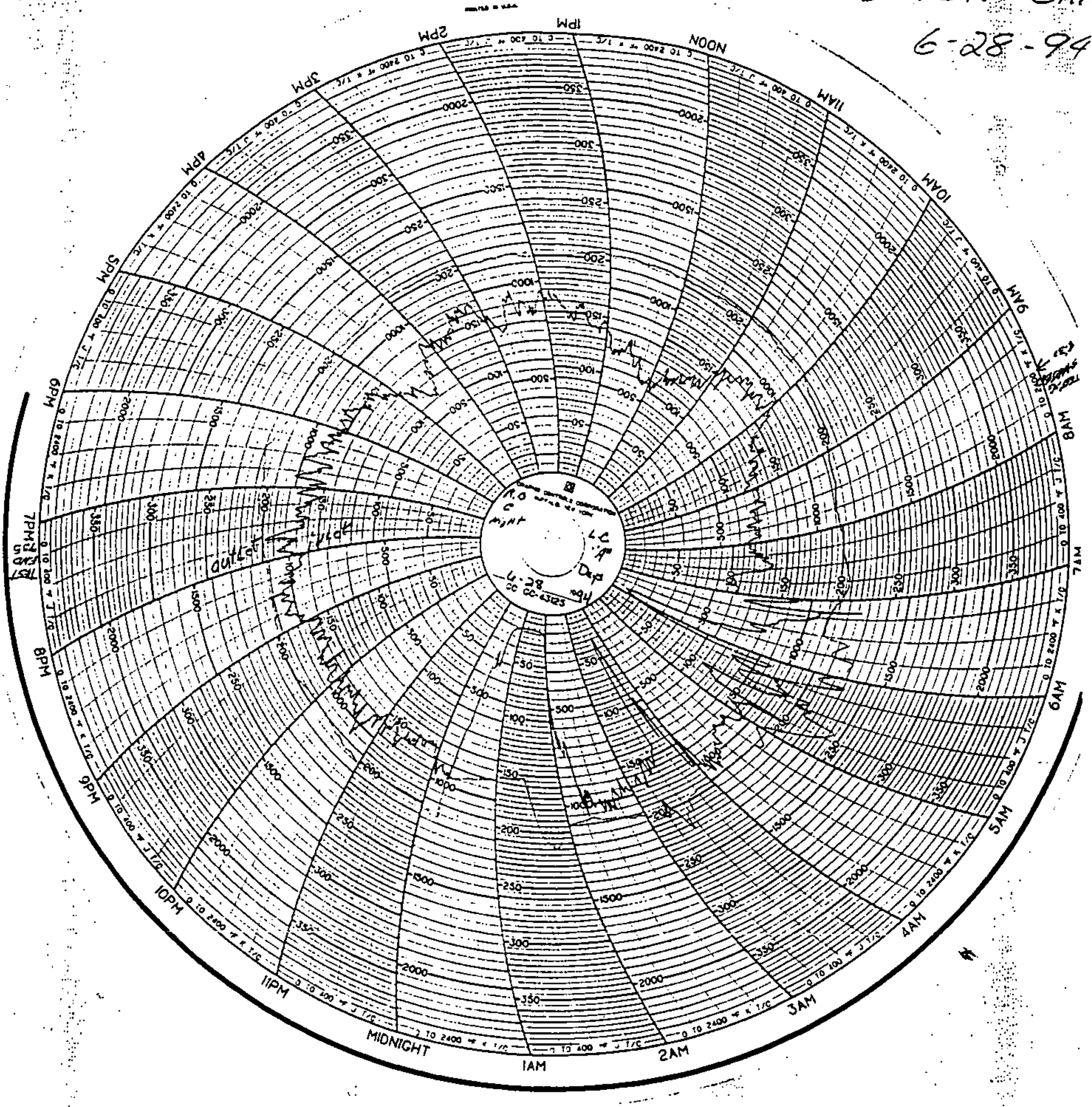
DOWNTIME FROM	DOWNTIME TO	DOWNTIME (Mins.) M	E	O	KEY	REASONS FOR DOWNTIME
9:37	9:47				10	TSF Spreading rolls kicked out

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

DRYER CHART
6-28-94



DRYER INLET-outlet
CHART
JUNE 28, 1994

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DRYER DATA SHEET

DATE 6-28-94
BY Rodney Lane
(NOTE ANY CHANGES IN SETPOINTS)

PLANT:
REVOLUTIONS per MINUTE:
FUEL CALIBRATION:

TIME	OUTLET SET POINT	FEED RATE	DRYER INLET TEMP	DRYER OUTLET TEMP	FUEL COUNT	WET BIN LEVEL	DRY BIN LEVEL		EVERY HOUR FLAKE MOISTURE	
							SUR.	CORE	IN	OUT
7:00	191	59	601	190	16	Full	3/4	3/4		
7:10	194	59	590	191	84	Full	3/4	3/4		
7:20	198	57	555	196	137	Full	3/4	3/4		
7:30	208	60	737	202	206	3/4	3/4	3/4		
7:40	200	62	740	204	284	Full	3/4	3/4		
7:50	200	64	629	202	343	3/4	3/4	3/4		
8:00	197	62	607	198	405	Full	3/4	3/4	38.2	7.8
8:10	196	62	692	196	476	Full	3/4	3/4		
8:20	194	62	631	195	536	3/4	3/4	3/4		
8:30	192	62	685	192	599	3/4	3/4	3/4		
8:40	192	62	729	190	674	Full	3/4	3/4		
8:50	194	62	719	192	742	Full	3/4	3/4		
9:00	194	62	641	194	812	3/4	3/4	3/4	41.9	8.5
9:10	194	62	670	193	868	3/4	3/4	3/4		
9:20	197	62	726	194	950	3/4	3/4	3/4		
9:30	200	62	758	198	1018	3/4	3/4	3/4		
9:40	202	60	771	201	1097	3/4	3/4	3/4		
9:50	202	60	825	202	1182	1/4	3/4	3/4		
10:00	202	60	837	202	1267	1/2	3/4	3/4	42.0	8.3
10:10	203	58	923	201	1354	1/2	3/4	3/4		
10:20	207	58	892	206	1432	Full	3/4	3/4		
10:30	206	59	921	207	1528	3/4	3/4	3/4		
10:40	204	59	927	206	1603	Full	3/4	3/4		
10:50	205	58	841	205	1689	3/4	3/4	3/4		
11:00	206	58	835	206	1755	Full	3/4	3/4	39.4	7.7
11:10	206	58	750	206	1827	Full	3/4	3/4		
11:20	206	58	737	206	1908	Full	3/4	3/4		
11:30	206	60	715	206	1957	3/4	3/4	3/4		
11:40	204	62	636	205	2033	3/4	3/4	3/4		
11:50	202	63	606	205	2100	3/4	3/4	3/4		

2MA1)
2V #1
FTED →

V #1
ENDED) →
5 51

POZMA1)
V #2 →
:25

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DRYER DATA SHEET

DATE 6-28-94
BY Rodney Lane
(NOTE ANY CHANGES IN SETPOINTS)

PLANT:
REVOLUTIONS per MINUTE:
FUEL CALIBRATION:

TIME	OUTLET SET POINT	FEED RATE	DRYER INLET TEMP	DRYER OUTLET TEMP	FUEL COUNT	WET BIN LEVEL	DRY BIN LEVEL		EVERY HOUR FLAKE MOISTURE	
							SUR.	CORE	IN	OUT
12:00	202	65	606	202	2147	3/4	3/4	3/4	42.9	8.2
12:10	202	65	557	203	2213	1/4	3/4	3/4		
12:20	202	66	619	203	2292	1/4	3/4	3/4		
12:30	202	67	667	202	2341	1/4	3/4	3/4		
12:40	202	67	683	203	2420	1/2	3/4	3/4		
12:50	202	67	650	202	2500	3/4	3/4	3/4		
1:00	202	68	817	201	2[illegible]581	3/4	3/4	3/4	44.9	7.2
1:10	202	68	781	202	2648	Full	3/4	3/4		
1:20	202	68	839	201	2724	3/4	3/4	3/4		
1:30	200	69	832	201	2834	3/4	3/4	3/4		
1:40	200	69	865	200	2905	3/4	3/4	3/4		
1:50	198	69	935	199	2977	Full	3/4	3/4		
2:00	195	69	914	196	3070	3/4	3/4	3/4	45.3	7.5
2:10	194	67	868	196	3157	3/4	3/4	3/4		
2:20	196	67	886	194	3254	Full	3/4	3/4		
2:30	196	67	898	194	3326	Full	3/4	3/4		
2:40	198	65	777	200	3442	Full	3/4	3/4		
2:50	198	65	759	198	3501	~~3/4~~ 1/2	3/4	3/4		
3:00	198	65	849	198	3614	1/4	3/4	3/4	45.8	6.3
3:10	198	65	943	197	3665	1/4	3/4	3/4		
3:20	198	65	941	198	3770	1/2	3/4	3/4		
3:30	202	65	925	201	3852	3/4	3/4	3/4		
3:40	201	66	832	203	3943	Full	3/4	3/4		
3:50	201	66	806	202	4015	3/4	3/4	3/4		
4:00	201	66	817	202	4079	Full	3/4	3/4	45.3	7.9
4:10	201	66	822	202	4184	Full	3/4	3/4		
4:20	201	66	750	202	4237	3/4	3/4	3/4		
4:30	196	66	622	201	4318	3/4	3/4	3/4		
4:40	196	67	649	196	4387	3/4	3/4	3/4		
4:50	194	67	702	195	4470	Full	3/4	3/4		

DRYER DATA SHEET

DATE 6-28-94
BY Rodney Lane
(NOTE ANY CHANGES IN SETPOINTS)

PLANT:
REVOLUTIONS per MINUTE:
FUEL CALIBRATION:

TIME	OUTLET SET POINT	FEED RATE	DRYER INLET TEMP	DRYER OUTLET TEMP	FUEL COUNT	WET BIN LEVEL	DRY BIN LEVEL		EVERY HOUR FLAKE MOISTURE	
							SUR.	CORE	IN	OUT
5:00	194	67	750	193	4533	3/4	3/4	3/4	46.3	6.1
5:10	196	67	754	195	4610	3/4	3/4	3/4		
5:20	199	67	821	196	4681	3/4	3/4	3/4		
5:30	198	67	792	198	4766	3/4	3/4	3/4		
5:40	198	67	866	198	4846	3/4	3/4	3/4		
5:50	196	67	892	197	4941	3/4	3/4	3/4		
6:00	196	67	838	197	5039	3/4	3/4	3/4	51.7	8.7
6:10	196	67	866	198	5117	3/4	3/4	3/4		
6:20	196	67	929	196	5184	Full	3/4	3/4		
6:30	202	66	953	197	5293	Full	3/4	3/4		
6:40	206	64	831	204	5366	Full	3/4	3/4		
6:50	208	64	1005	205	5463	Full	3/4	3/4		
7:00	208	64	902	208	5576	3/4	3/4	3/4		
7:10	203	64	853	205	5671	Full	3/4	3/4		
7:20	203	64	926	203	5782	3/4	3/4	3/4		
7:30	203	64	974	202	5891	3/4	3/4	3/4		

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EFB READINGS

DATE 6-28-94
BY R. Vautrin

PLANT: ______

(Take readings every 10 minutes)

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.
AM 7:00	15	0	35	5	15	.05	35	.6	0	4.6
7:10	15	0	34	1	15	.05	35	.7	0	4.6
7:20	15	0	34	1	15	.05	36	.7	0	4.6
7:30	13	.02	36	2	15	.05	39	.7	0	4.7
7:40	13.5	.02	36	2	15	.05	40	.7	0	4.8
7:50	13.7	0	36	2	15	.05	40	.7	0	4.8
8:00	14	0	36	2	15	.05	39	.7	0	4.8
8:10	13.5	0	36	2	15	.05	39	.7	0	4.8
8:20	13.6	0	36	2	15	.05	39	.7	0	5
8:30	15	.02	36	2	15	.05	39	.7	0	0
8:40	14	.02	36	2.4	15	.05	39	.7	0	0
8:50	14	.02	36	2.4	15	.05	39	.7	0	0
9:00	14	.02	36	2.3	15	.05	39	.7	0	0
9:10	14	.02	36	2.2	15	.05	39	.7	0	0
9:20	13	.03	35	2.5	15	.05	40	.7	0	4.4
9:30	13	.03	36	2.4	15	.05	40	.7	0	4.4
9:40	15	.04	36	2.5	15	.05	40	.7	0	4.7
9:50	14	.04	35	2.5	15	.05	39	.7	0	4.8
10:00	13.4	.1	36	2.4	15	.04	39	.7	0	5
10:10	13	.06	35	2.7	15	.05	39	.7	0	4.6
10:20	13.4	.06	36	2.4	15	.05	38	.6	0	4.2
10:30	13.2	.06	36	2.4	15	.05	38	.7	0	4.1
10:40	15	.08	36	2.3	15	.05	38	.7	0	4.1
10:50	14	.06	36	2.4	15	.05	39	.7	0	4.1
11:00	15	.05	36	2.3	15	.05	39	.7	0	4.1
11:10	14	.04	36	2.1	15	.05	39	.7	0	4.2
11:20	14	.04	36	2.0	15	.05	39	.6	0	4.2
11:30	14	.04	37	2.0	15	.05	38	.6	0	3.9
11:40	14	.02	37	1.8	15	.05	38	.7	0	4.5
11:50	14	.02	37	1.9	15	.05	39	.7	0	0

EFB READINGS

DATE 6-28-94
BY R. Vautrin

PLANT: ____________________

(Take readings every 10 minutes)

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.
12:00	14	.02	37	1.9	15	.05	39	.7	0	0
12:10	14	.02	37	1.9	15	.05	40	.7	0	0
12:20	14	.03	36	2.1	15	.05	39	.7	0	4.2
12:30	14	.04	36	2.2	15	.05	39	.6	0	3.9
12:40	14	.04	36	2.2	15	.05	40	.8	0	4.0
12:50	14	.05	36	2.0	15	.05	39	.7	0	4.2
1:00	14	.1	36	2.3	15	.05	38	.7	0	4.1
1:10	14	.1	36	2.2	15	.05	38	.6	0	4.0
1:20	14	.18	35	2.4	15	.03	38	.6	0	4.0
1:30	14	.18	35	2.4	15	.05	39	.6	0	4.0
1:40	14	.17	35	2.4	15	.05	39	.7	0	4.0
1:50	14	.18	36	2.5	15	.05	39	.7	0	4.7
2:00	14	.20	35	2.5	15	.05	39	.6	0	4.9
2:10	14	.20	36	2.4	15	.05	39	.7	0	5.0
2:20	13	.21	36	2.4	15	.05	39	.7	0	5.4
2:30	13	.24	36	2.4	15	.05	39	.6	0	0
2:40	13	.25	36	2.2	15	.05	39	.7	0	4.1
2:50	14	.15	36	2.2	15	.05	39	.7	0	4.0
3:00	14	.22	36	2.3	15	.04	40	.7	0	3.9
3:10	13	.26	36	2.2	15	.05	38	.7	0	4.0
3:20	13	.24	36	2.0	15	.05	39	.7	0	4.3
3:30	13	.21	36	2.0	15	.05	39	.7	0	5.4
3:40	14	.16	36	1.9	15	.05	39	.7	0	3.7
3:50	14	.17	36	1.9	15	.05	39	.7	0	3.2
4:00	15	.15	37	1.9	15	.05	39	.7	0	3.1
4:10	14	.15	36	1.9	15	.05	39	.6	0	2.2
4:20	15	.10	37	1.7	15	.05	39	.5	0	3.5
4:30	14	.06	37	1.6	15	.05	39	.7	0	4.6
4:40	14	.06	37	1.7	15	.05	39	.7	0	4.0
4:50	14	.07	37	1.9	15	.05	39	.7	0	4.0

EFB READINGS

DATE 6-28-94
BY R. Vautrin

PLANT:

(Take readings every 10 minutes)

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.
5:00	14	.09	36	2.3	15	.05	41	.7	0	4.3
5:10	14	.12	36	2.4	15	.05	41	.7	0	4.9
5:20	14	.16	35	2.5	15	.05	41	.7	0	5.2
5:30	14	.17	36	2.3	15	.05	41	.7	0	5.2
5:40	14	.20	36	2.2	15	.05	41	.7	0	5.3
5:50	14	.21	36	2.4	15	.05	41	.7	0	5.4
6:00	14	.17	36	2.2	15	.05	41	.7	0	5.5
6:10	14	.20	36	2.0	15	.05	42	.7	0	5.5
6:20	14	.21	36	2.0	15	.05	41	.7	0	5.4
6:30	14	.24	36	2.3	15	.05	42	.7	0	5.6
6:40	14	.20	36	2.0	15	.05	43	.7	0	5.7
6:50	13	.26	36	2.0	15	.05	42	.7	0	4.4
PM 7:00	14	.19	37	1.8	15	.05	42	.7	0	4.2
7:10	14	.18	37	2.0	15	.05	43	.7	0	4.2
7:20	14	.20	37	.2.0	15	.04	43	.7	0	4.2

DATE 6-28-94
BY Rodney Lane

KONUS DATA

PLANT:

OIL SETPOINT 550 °C

(NOTE ANY CHANGES IN SETPOINTS)

	TIME	PRIMARY AIR LEFT	I.D. FAN	PRIMARY AIR RIGHT	OIL IN deg. C	OIL OUT deg. ~~F~~C	FUEL COUNT		FEED RATE SETTING		EVERY HOUR	
							LT	RT	LT	RT	BAG H. PRESS.	BARK MOISTURE
	7:00	200	-.9	220	511	536	36	31	68	69	.08	
	7:10	200	-.9	220	525	545	57	50	68	69	.08	
	7:20	200	-.9	230	523	542	85	75	68	69	.08	
	7:30	160	-.9	230	524	544	117	102	68	69	.08	
	7:40	160	-.9	230	521	542	147	137	68	69	.08	
	7:50	160	-.9	230	516	538	190	174	68	69	.08	
	8:00	160	-.9	230	512	533	237	215	68	69	.08	38.1
	8:10	160	-.9	230	515	534	279	251	50	45	.08	
[illegible]	8:20	160	-.9	230	503	526	318	283	68	69	.08	
RUN #1 START →	8:30	160	-.9	230	510	535	352	314	68	69	.08	
	8:40	160	-.9	230	511	534	414	368	68	69	.07	
	8:50	160	-.9	230	518	541	462	406	68	69	.08	
	9:00	160	-.9	230	520	541	487	427	68	69	.09	38.6
	9:10	160	-.9	230	519	536	529	460	68	69	.09	
	9:20	160	-.9	230	522	549	569	494	68	69	.09	
	9:30	160	-.9	230	521	539	598	514	68	69	.09	
	9:40	160	-.9	230	514	537	636	543	55	50	.09	
[illegible]	9:50	160	-.9	230	531	548	653	556	45	40	.09	
RUN #2 → 10'05 AM	10:00	160	-.9	230	531	544	662	562	45	40	.09	37.2
	10:10	160	-.9	230	512	534	700	587	45	40	1.0	
	10:20	160	-.9	230	509	531	737	609	55	40	.09	
	10:30	160	-.9	230	509	533	782	636	55	40	1.0	
	10:40	160	-.9	230	520	543	812	655	35	30	.09	
	10:50	160	-.9	230	512	531	855	680	55	40	1.0	
[illegible] #2 ENDED	11:00	160	-.9	230	512	532	883	700	45	40	1.0	40.7
11:12	11:10	160	-.9	230	513	536	923	728	35	40	.08	
[illegible])	11:20	160	-.9	230	505	523	957	753	55	50	.09	
RUN #3 STARTED	11:30	160	-.9	230	501	522	996	780	67	50	.09	
·37	11:40	160	-.9	230	506	533	1041	808	57	50	1.0	
	11:50	160	-.9	230	508	529	1087	837	57	50	1.0	

DATE 6-28-94

BY Rodney Lane

KONUS DATA

PLANT:

OIL SETPOINT 550° C

(NOTE ANY CHANGES IN SETPOINTS)

TIME	PRIMARY AIR LEFT	I.D. FAN	PRIMARY AIR RIGHT	OIL IN deg. C	OIL OUT deg. ~~F~~C	FUEL COUNT		FEED RATE SETTING		EVERY HOUR	
						LT	RT	LT	RT	BAG H. PRESS.	BARK MOISTURE
12:00	160	-.9	230	509	528	1146	876	67	50	1.0	45.3
12:10	160	-.9	230	515	542	1192	909	47	50	1.0	
12:20	160	-.9	230	518	538	1235	937	47	40	1.0	
12:30	160	-.9	230	517	536	1250	948	57	40	1.0	
12:40	160	-.9	230	520	545	1298	977	47	40	1.0	
12:50	160	-.9	230	522	544	1332	1001	47	40	1.0	
1:00	160	-.9	230	520	540	1366	1025	47	40	1.0	42.1
1:10	160	-.9	230	512	530	1404	1048	47	40	0.9	
1:20	160	-.9	230	508	530	1437	1071	47	40	0.9	
1:30	160	-.9	230	506	526	1474	1096	57	50	1.0	
1:40	160	-.9	230	501	518	1511	1122	57	50	1.0	
1:50	160	-.9	230	495	514	1560	1154	67	60	1.0	
2:00	160	-.9	230	497	517	1604	1184	67	60	1.0	41.8
2:10	160	-.9	230	509	534	1660	1224	57	50	1.0	
2:20	160	-.9	230	511	534	1700	1252	57	50	1.0	
2:30	160	-.9	230	515	533	1740	1282	57	40	1.0	
2:40	160	-.9	230	520	538	1783	1307	47	40	1.1	
2:50	160	-.9	230	525	547	1807	1324	37	40	1.2	
3:00	160	-.9	230	516	537	1841	1351	37	40	0.8	37.6
3:10	160	-.9	230	518	539	1863	1369	37	40	0.8	
3:20	160	-.9	230	518	538	1892	1392	37	40	0.8	
3:30	160	-.9	230	511	528	1929	1419	47	40	1.0	
3:40	160	-.9	230	507	531	1963	1440	47	40	1.0	
3:50	160	-.9	230	504	523	2005	1470	57	50	1.0	
4:00	160	-.9	230	502	523	2041	1500	57	50	1.0	42.7
4:10	160	-.9	230	510	531	2082	1535	57	60	1.0	
4:20	160	-.9	230	504	522	2121	1568	57	60	1.0	
4:30	160	-.9	230	499	519	2162	1604	57	60	1.0	
4:40	160	-.9	230	501	522	2211	1649	57	60	1.0	
4:50	160	-.9	230	502	520	2252	1681	57	60	1.0	

DATE 6-28-94

BY Rodney Lane

KONUS DATA

PLANT:

OIL SETPOINT 550 °C

(NOTE ANY CHANGES IN SETPOINTS)

TIME	PRIMARY AIR LEFT	I.D. FAN	PRIMARY AIR RIGHT	OIL IN deg. C	OIL OUT deg. C	FUEL COUNT		FEED RATE SETTING		EVERY HOUR	
						LT	RT	LT	RT	BAG H. PRESS.	BARK MOISTURE
5:00	160	-.9	230	499	519	2301	1702	67	60	1.1	39.8
5:10	160	-.9	230	501	528	2335	1729	57	50	1.1	
5:20	160	-.9	230	510	535	2387	1761	57	50	1.1	
5:30	160	-.9	230	514	535	2417	1785	57	50	1.1	
5:40	160	-.9	230	515	535	2453	1808	57	50	1.1	
5:50	160	-.9	230	519	541	2511	1849	47	40	1.1	
6:00	160	-.9	230	518	537	2549	1873	57	50	1.1	39.6
6:10	160	-.9	230	518	538	2590	1903	57	50	1.1	
6:20	160	-.9	230	518	542	2621	1925	57	50	1.0	
6:30	160	-.9	230	523	546	2666	1956	57	50	1.0	

LOUISIANA-PACIFIC CORPORATION
DUNGANNON, VIRGINIA

MOISTURE CONTENT

10 min 4 min 10 min.

DATE	TIME A.M	WET FLAKE %	DRY FLAKE %	KONUS FUEL %	NAME
6/29/94	7:00	45	7.6	43.7	C. Johnson
6/29/94	8:00	42.4	7.2	46.6	C. Johnson
6/29/94	9:00	50.1	6.9	40.0	C. Johnson
6/29/94	10:00	47.4	8.1	43	C. Johnson
6/29/94	11:00	49.2	8.3	45.8	C. Johnson
6/29/94	12:00	47.5	10.7	42.2	C. Johnson
6/29/94	1:00	41.6	6.0	43.4	C. Johnson
6/29/94	2:00	40.2	DOWN	42.7	C. Johnson
6/29/94	3:00	37.1	DOWN	47.1	C. Johnson
6/29/94	4:00	40.5	5.6	41.1	C. Johnson
6/29/94	5:00	47.3	7.8	46.0	C. Johnson
6/29/94	6:00	43.3	6.7	49.4	C. Johnson
6/29/94	7:00	43.4	7.8	48.9	H Hall
6/29/94	8:00	39.5	9.3	45.0	H. Hall
6/29/94	9:00	43.9	9.4	44.2	H. Hall
6/29/94	10:00	48.9	8.0	52.3	H. Hall
6/29/94	11:00	41.8	7.0	48.6	H. Hall

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PRESS VENT TESTING 6-29-94 MDI VOC
DATA TIME: START= 09:00 END= 14:00 HOURS= 5.00

BOARD WEIGHTS - LBS

weights of approximately every 25th untrimmed board (from press tapes)

195	187	193
203	194	190
198	195	198
190	188	
194	185	
190	184	
190	182	
188	202	
194	195	
194	192	

192.22 lb.=average untrimmed mat weight

175.11 lb.=average finished board weight (untrimmed mat weight-trim weight)

8.9% = TRIM

PLANT PRODUCTION RATE

5.00 =hours during testing
68 =pressloads
544 =no. of 8'x16' boards produced (pressloads x 8 boards per load)
95260 =lbs of finished product (boards produced x weight of finished board)
19052 =lbs of finished product per hour (lbs of finshed product / hours)
9.53 =tons of finished product per hour (lbs of finshed product per hour / 2000 lb)

RESIN USAGE FROM FLOW CHARTS

200 = LBS OF MDI RESIN PER HOUR
19052 =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
2.28% = LIQUID PHENOLIC RESIN USED AS % OF FINAL PRODUCT

WAX USAGE FROM DAILY INVENTORY SHEET

8226 = LBS OF WAX USED FOR THE DAY @ 48% SOLIDS
4278 = LBS OF WAX USED FOR THE DAY @ 100% SOLIDS
357216 =PRODUCTION FOOTAGE FOR THE DAY - 3/8" BASIS
306185 =PRODUCTION FOOTAGE FOR THE DAY - 7/16" BASIS ((3/8" FOOTAGE)/ (7/16" / 3/8"))
2392 =NO OF 8'x16' BOARDS PRODUCED (7/16" FOOTAGE / (8'X16"))
175.11 =WEIGHT OF FINISHED 8'x16'7/16" BOARD
418863 = TOTAL LBS OF BOARD PRODUCED (NO. OF BOARDS x BOARD WEIGHT)
1.02% =WAX AS % OF FINAL PRODUCT

19052 =LBS FINISHED PRODUCT PRODUCED PER HOUR
195 = LBS OF WAX USED PER HOUR DURING TESTING (% WAX x LBS FINISHED PRODUCT PER HOUR)

PRESS VENT TESTING 6-29-94 FORMALDEHYDE PHENOL
DATA TIME: START= 15:30 END= 20:00 HOURS= 4.50

BOARD WEIGHTS - LBS
weights of approximately every 25th untrimmed board (from press tapes)

192	196
190	194
196	194
198	191
210	193
208	186
205	193
190	193
187	188
194	194

194.6 lb.=average untrimmed mat weight

177.28 lb.=average finished board weight (untrimmed mat weight-trim weight)

8.9% = TRIM

PLANT PRODUCTION RATE

4.50 =hours during testing
61 =pressloads
488 =no. of 8'x16' boards produced (pressloads x 8 boards per load)
86513 =lbs of finished product (boards produced x weight of finished board)
19225 =lbs of finished product per hour (lbs of finshed product / hours)
9.61 =tons of finished product per hour (lbs of finshed product per hour / 2000 lb)

RESIN USAGE FROM FLOW CHARTS

200 = LBS OF MDI RESIN PER HOUR
19225 =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

8226 = LBS OF WAX USED FOR THE DAY @ 48% SOLIDS
4278 = LBS OF WAX USED FOR THE DAY @ 100% SOLIDS
357216 =PRODUCTION FOOTAGE FOR THE DAY - 3/8" BASIS
306185 =PRODUCTION FOOTAGE FOR THE DAY - 7/16" BASIS ((3/8" FOOTAGE)/ (7/16" / 3/8"))
2392 =NO OF 8'x16' BOARDS PRODUCED (7/16" FOOTAGE / (8'X16"))
177.28 =WEIGHT OF FINISHED 8'x16'7/16" BOARD
424054 = TOTAL LBS OF BOARD PRODUCED (NO. OF BOARDS x BOARD WEIGHT)
1.01% =WAX AS % OF FINAL PRODUCT

19225 =LBS FINISHED PRODUCT PRODUCED PER HOUR
194 = LBS OF WAX USED PER HOUR DURING TESTING (% WAX x LBS FINISHED PRODUCT PER HOUR)

DRYER TESTING 6-29-94 NOX

DATA TIM	START=	18:00	END=	19:20	HOURS=	1.33
	START=	20:50	END=	23:00	HOURS=	2.17
						3.50

BOARD WEIGHTS - LBS

weights of approximately every 25th untrimmed board (from press tapes)

196	186
194	192
194	194
191	196
193	190
186	194
191	180
192	
185	
190	

190.82 lb.=average untrimmed mat weight

173.84 lb.=average finished board weight (untrimmed mat weight-trim weight)

8.9% = TRIM

PLANT PRODUCTION RATE

3.50 =hours during testing
47 =pressloads
376 =no. of 8'x16' boards produced (pressloads x 8 boards per load)
65364 =lbs of finished product (boards produced x weight of finished board)
18675 =lbs of finished product per hour (lbs of finshed product / hours)
9.34 =tons of finished product per hour (lbs of finshed product per hour / 2000 lb)

DRYER PRODUCTION RATE:

22473 =lb of dryer production per hour (lb of finished product/(1-(%trim + %fines)
8.0% =%fines
8.9% =%trim
44.3% =moisture content of incoming wood
7.8% =moisture content of dried wood

930 =average inlet temerature

DRYER FUEL BURNING RATE

7.61 =fuel calibraton in lbs per count
1632 =total counts during testing
3.50 =hours during testing

12420 =total lbs. of fuel bumed during testing (counts x calibration)
3549 =lbs of fuel bumed per hour during testing (total lbs / hours)

1.77 =tons of fuel bumed per hour during testing (lbs per hour / 2000 lbs)

8600 =estimated BTU content per lb of fuel
30.5 =estimated mmBTU input per hour (lbs of fuel per hour x BTU content)

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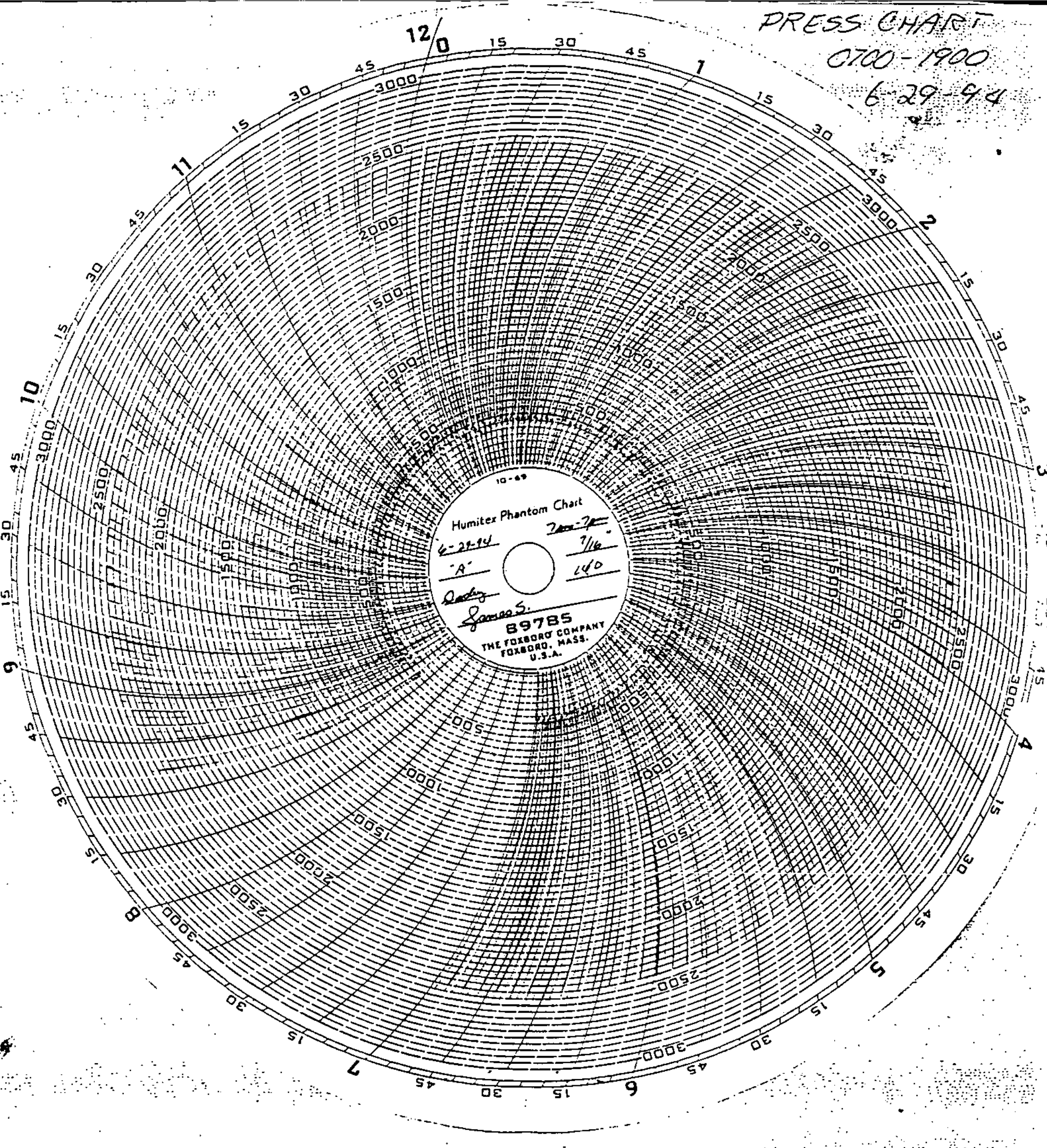
PRESS CHART
0700-1900
6-29-94



10-69

Humitex Phantom Chart

6-29-94
7am-7pm
7/16
"A"
140
Sammo S.

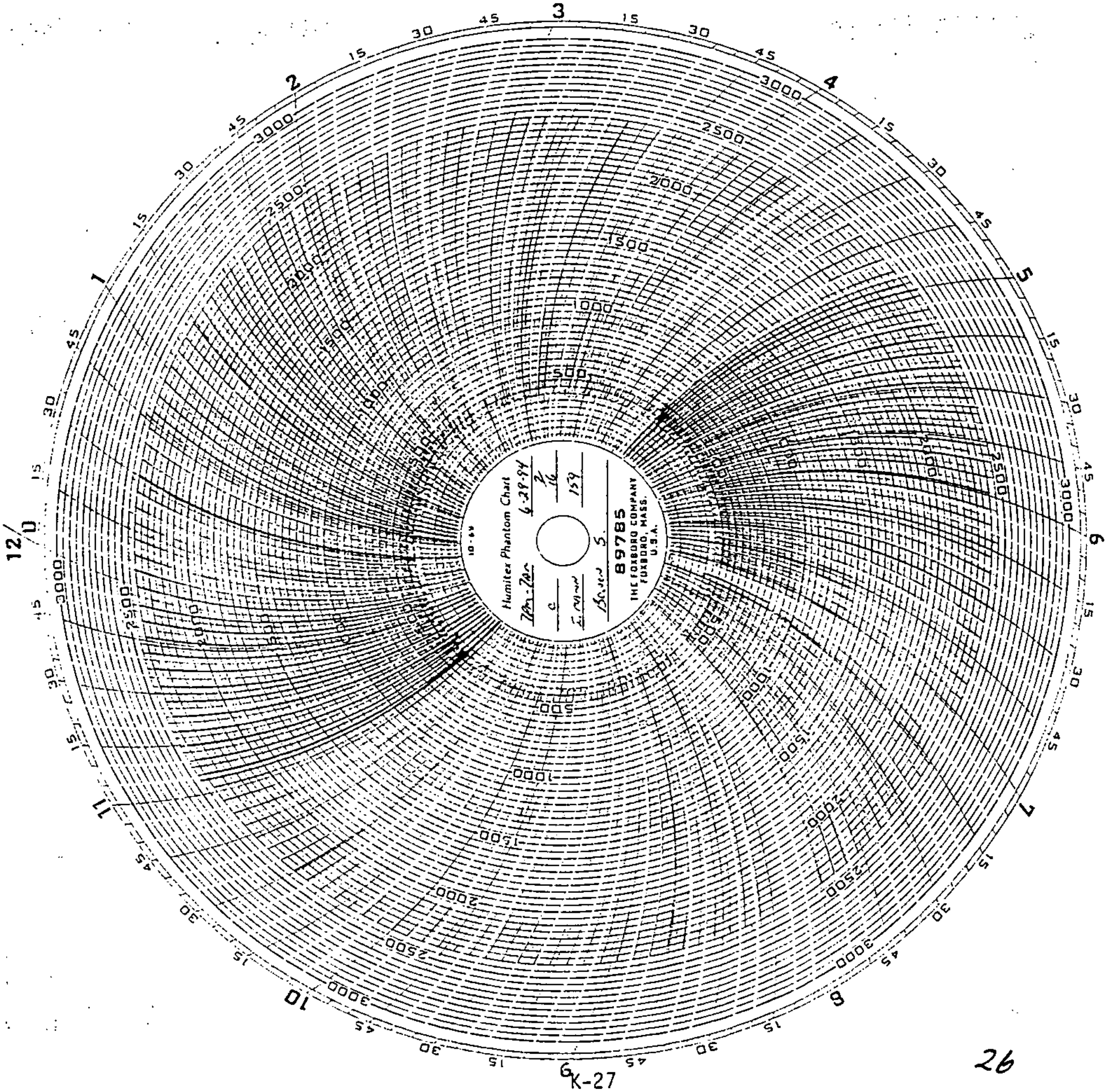
89785
THE FOXBORO COMPANY
FOXBORO, MASS.
U.S.A.

25

7PM- 7AM

Test PAPERS
SHIFT REPORTS
JUNE 29. 1994

PRESS CHART
6-29 94
1900 -0700



LOUISIANA-PACIFIC CORPORATION
DUNGANNON, VIRGINIA

PRESS REPORT

OPERATOR James S.
SHIFT 7am - 7pm
CREW "A"
DATE 6-29-94
THICKNESS: 7/16"
PRESS LOADS 140 - 167,258
OVERALL TIMER:
DECOMPRESSION TIME
PRESS TEMP: 400°

BLENDER SHUTDOWNS
CORE 20
SURFACE 18

	CORE RESIN	SURFACE RESIN
BEGIN	1522831	6371160
END	1524771	6379198

LINE SPEED	FROM	TO
31	7:00	7:00

Cleaned Blender Shrouds & Tracks

Former hydraulic and radiater blown out

FCOS hydraulic unit and radiater blown out

Blender outfeed conv. tail pulleys cleaned

DOWNTIME FROM	DOWNTIME TO	DOWNTIME (Mins.) M	E	O	KEY	REASONS FOR DOWNTIME
12:23	12:24				1	Filling low former.
2:03	3:39				96	No waffer, Cylinder blown at waffer[illegible].
3:42	3:46				4	Chunk of resin hung in surface blender chute.

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)

OUISIANA-PACIFIC CORPORATION
DUNGANNON, VIRGINIA

PRESS REPORT

PERATOR Bowen S. SHIFT 7pm - 7Am CREW C DATE 6-29-94

ThICKNESS: 7/16

PRESS LOADS 159 - 189,957

BLENDER SHUTDOWNS
CORE 17
SURFACE 13

VERALL TIMER:

DECOMPRESSION TIME

RESS TEMP: 400°

	CORE RESIN	SURFACE RESIN
BEGIN	1524771	6379198
END	1526759	6388035

LINE SPEED	FROM	TO
31	7pm	7AM

Cleaned Blender Shrouds & Tracks

Former hydraulic and radiater blown out

FCOS hydraulic unit and radiater blown out

Blender outfeed conv. tail pulleys cleaned

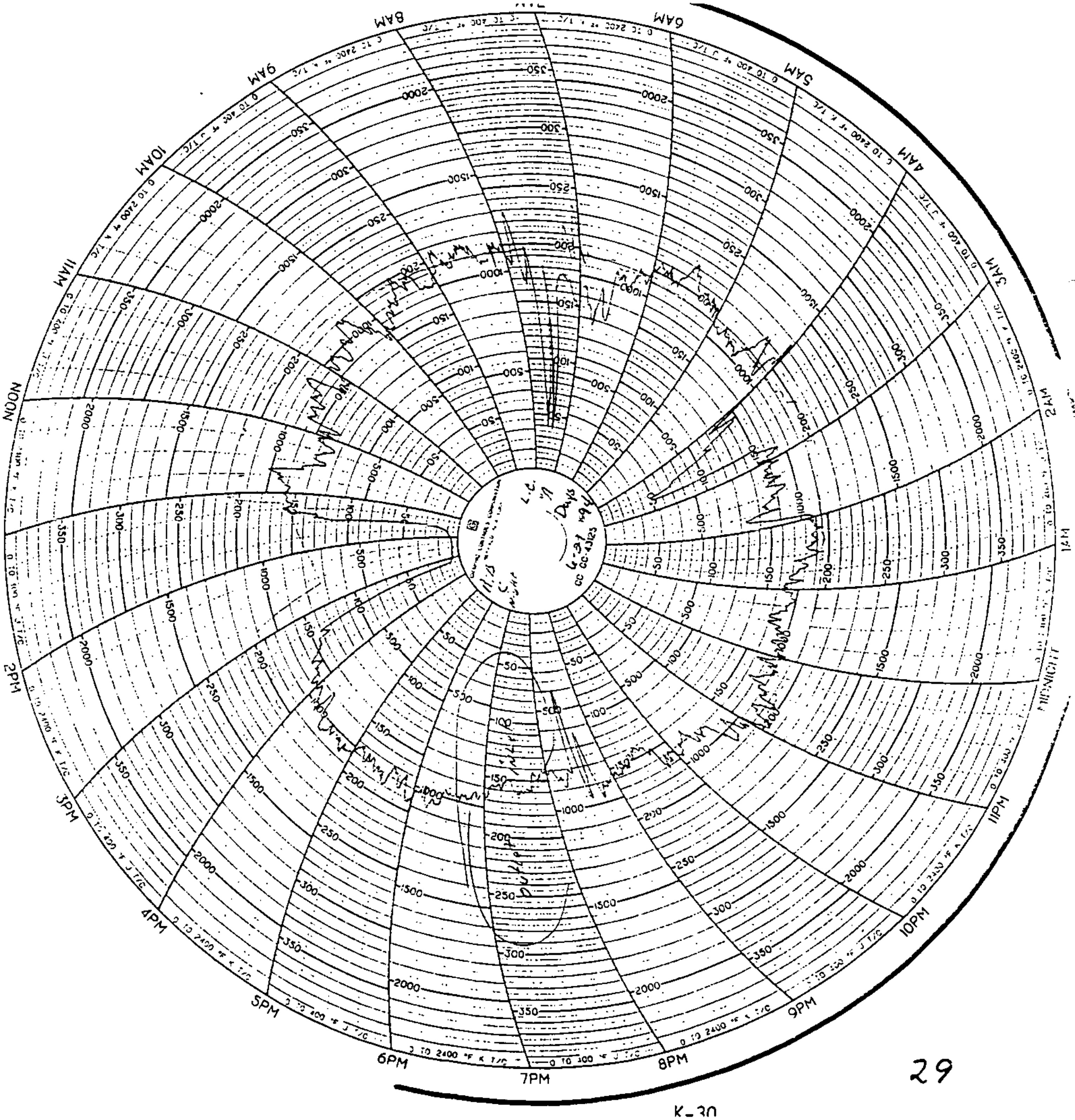
DOWNTIME		DOWNTIME (Mins.)			KEY	REASONS FOR DOWNTIME
FROM	TO	M	E	O		
2:05	2:11	✓			6	T.S.F. Spreading Roll BelT came off.
25	3:19	✓			14	Surface Blender Plugged.

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

DRYER CHART
6-29-94



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K-30

SENT BY:LOUISIANA-PACIFIC ; 3-25-94 ; 1:47PM ; ENGINEERING DEPT.→ 17034872815;# 2

DRYER DATA SHEET

DATE 6-29-94
BY R. Vautrin
(NOTE ANY CHANGES IN SETPOINTS)

PLANT: LP- DUNGANNON
REVOLUTIONS per MINUTE:
FUEL CALIBRATION:

TIME	OUTLET SET POINT	FEED RATE	DRYER INLET TEMP	DRYER OUTLET TEMP	FUEL COUNT	WET BIN LEVEL	DRY BIN LEVEL		EVERY HOUR FLAKE MOISTURE	
							SUR.	CORE	IN	OUT
PM 4:30	196	68	1051	196	3874	Full	1/4	1/4		
4:40	193	68	1003	193	3970	Full	1/4	1/4		
4:50	190	68	1053	190	4054	Full	1/4	1/4		
5:00	192	68	1042	192	4157	Full	1/4	1/4	47.3	7.8
5:10	192	68	989	192	4236	2/3	1/4	1/4		
5:20	192	68	1008	192	4324	3/4	1/4	1/2		
5:30	192	68	1030	191	4419	3/4	1/4	1/4		
5:40	193	68	965	193	4521	3/4	1/2	1/4		
5:50	192	68	1089	191	4695	Full	1/2	1/2		
6:00	192	68	1047	191	4797	3/4	1/2	1/2	43.3	6.7
6:10	192	68	1036	191	4884	3/4	1/2	1/2		
6:20	192	68	972	191	4977	3/4	1/2	1/2		
6:30	191	68	985	191	5070	1/4	1/2	1/2		
6:40	191	68	971	191	5146	1/4	1/2	1/2		
6:50	191	68	929	191	5225	1/4	1/2	1/2		
7:00	191	68	934	191	5291	1/4	1/2	1/2	43.4	7.8
7:10	191	68	889	191	5322	1/4	1/2	1/2		
7:20	191	68	863	191	5401	1/2	1/2	1/2		
7:30	191	68	897	190	5482	1/2	1/2	1/2		
7:40	191	68	879	192	5576	1/2	1/2	1/2		
7:50	191	67	822	194	5658	1/2	1/2	1/2		
8:00	191	66	800	193	5732	1/2	1/2	1/2	39.5	9.3
8:10	195	66	824	193	5811	Full	1/2	1/2		
8:20	195	66	857	195	5894	3/4	1/2	1/2		
8:30	203	50	482	193	5958	Full	~~1/2~~ Full	3/4		
8:40	210	58	867	204	6024	Full	3/4	3/4		
8:50	195	66	927	192	6102	Full	3/4	3/4		
9:00	195	66	916	195	6172	3/4	3/4	3/4	43.9	9.4
9:10	195	66	898	195	6277	full	3/4	3/4		
9:20	195	66	872	195	6344	Full	3/4	3/4		

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DRYER DATA SHEET

DATE 6-29-94
BY R. Vautrin
(NOTE ANY CHANGES IN SETPOINTS)

PLANT: LP- DUNGANNON
REVOLUTIONS per MINUTE:
FUEL CALIBRATION:

TIME	OUTLET SET POINT	FEED RATE	DRYER INLET TEMP	DRYER OUTLET TEMP	FUEL COUNT	WET BIN LEVEL	DRY BIN LEVEL		EVERY HOUR FLAKE MOISTURE	
							SUR.	CORE	IN	OUT
PM 9:30	195	66	806	196	6425	Full	3/4	3/4		
9:40	195	66	811	195	6502	3/4	3/4	3/4		
9:50	196	66	946	194	6578	3/4	3/4	3/4		
10:00	196	66	917	196	6669	3/4	3/4	3/4	48.9	8.0
10:10	196	66	881	197	6752	3/4	3/4	3/4		
10:20	196	66	877	196	6839	3/4	3/4	3/4		
10:30	196	66	928	196	6910	full	3/4	3/4		
10:40	196	66	958	195	7009	3/4	3/4	3/4		
10:50	196	66	1071	196	7083	3/4	3/4	3/4		
11:00	196	66	962	195	7130	3/4	3/4	3/4	41.8	7.0

EFB READINGS

DATE 6-29-94
BY R. Vautrin

PLANT: LP- DUNGANNON

(Take readings every 10 minutes)

	"A" SIDE				"B" SIDE					
TIME	BED VOLT	BED CURR.	ION VOLT	ION CURR.	BED VOLT	BED CURR.	ION VOLT	ION CURR.	EFB PRESS.	BAG H. PRESS.
PM 4:30	6	.13	35	2.4	15	.05	42	.7	0	4.3
4:40	7.5	.1	35	2.4	15	.05	42	.7	0	4.3
4:50	12	.26	34	2.4	15	.05	42	.7	0	4.4
5:00	13	.26	35	2.3	15	.05	42	.7	0	4.9
5:10	13	.18	35	2.3	15	.05	42	.7	0	5.3
5:20	10	.16	35	2.3	15	.05	42	.7	0	5.6
5:30	9.5	.2	35	2.4	15	.05	42	.7	0	5.5
5:40	9.4	.2	35	2.2	15	.06	42	.7	0	5.5
5:50	9	.3	35	2.1	15	.05	42	.7	0	4.1
6:00	9	.24	35	2.2	15	.05	42	.7	0	4.7
6:10	7.5	.2	35	2.2	15	.65	42	.7	0	4.8
6:20	8	.17	35	2.2	15	.05	42	.7	0	5.0
6:30	9	.18	35	2.2	15	.05	42	.7	0	5.3
6:40	9.2	.17	35	2.1	15	.05	40	.7	0	5.4
6:50	10	.15	35	2.0	15	.05	42	.7	0	5.5
7:00	10	.16	35	2.0	15	.05	42	.6	0	5.5
7:10	10.5	.13	35	2.1	15	.05	42	.7	0	5.5
7:26	12	.14	35	2.1	15	.05	42	.7	0	5.6
7:30	9	.12	35	2.2	15	.05	42	.7	0	5.7
7:40	10	.12	35	2.3	15	.05	42	.7	0	4.8
7:50	12	.1	35	2.3	15	.05	42	.7	0	4.9
8:00	11	.08	35	2.2	15	.05	42	.7	0	4.7
8:10	10.5	.08	32	2.0	15	.05	42	.7	0	4.1
8:20	11	.08	32	2.0	15	.06	42	.7	0	4.7
8:30	15	.02	32	1.6	15	.05	42	.7	0	5.0
8:40	9	.1	33	2.0	15	.05	42	.7	0	5.2
8:50	8.8	.1	32	2.0	15	.05	42	.7	0	5.4
9:00	8.8	.1	32	2.0	15	.05	42	.7	0	5.4
9:10	9	.1	32	2.0	15	0.5	42	.7	0	5.7
9:20	9	.1	32	1.9	15	.05	42	.7	0	4.8

24.5
20.2
21.6
27.4

EFB READINGS

DATE 6-29-94
BY R. Vautrin

PLANT: LP — DUNGANNON

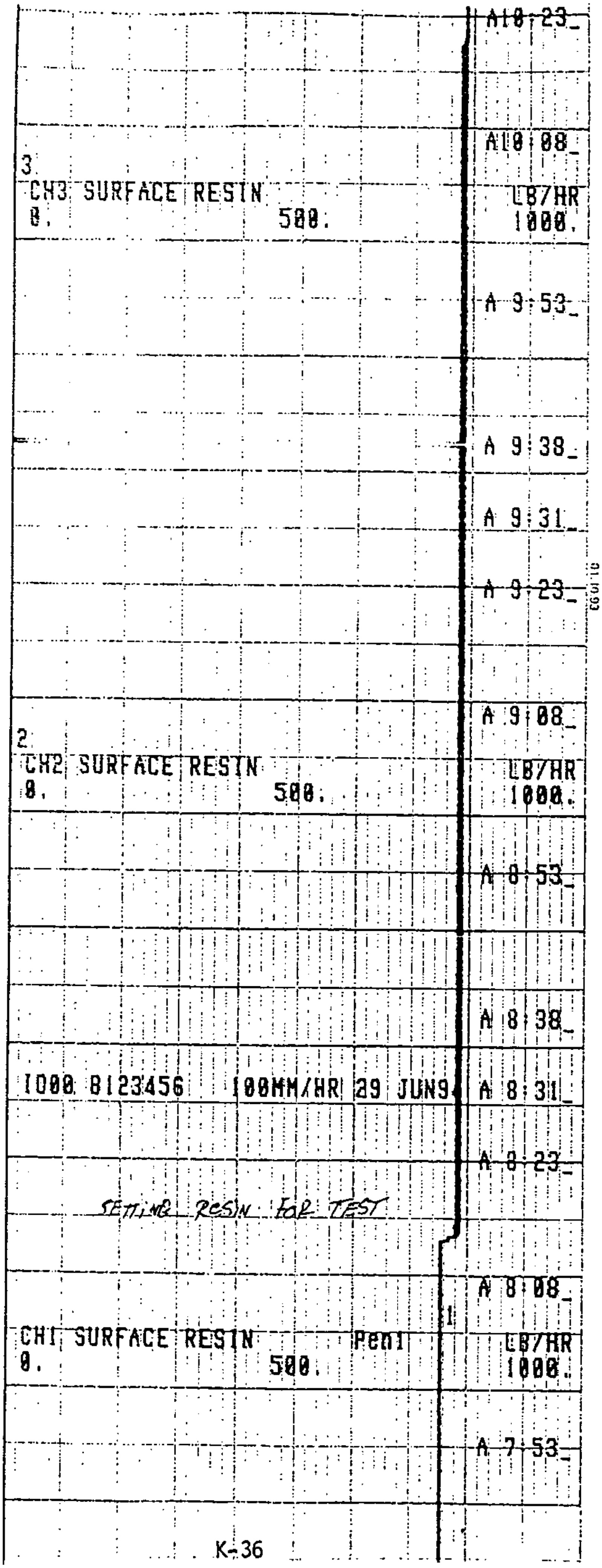
(Take readings every 10 minutes)

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.
9:30	10	.08	32	1.8	15	.05	42	.7	0	4.6
9:40	9.6	0.8	32	1.9	15	.05	42	.7	0	4.2
9:50	9	.1	32	1.9	15	.05	42	.7	0	5.0
10:00	9.4	.1	32	1.9	15	.05	42	.7	0	5.1
10:10	9.3	.1	32	1.8	15	.05	42	.7	0	5.1
10:20	9.3	.1	32	1.9	15	.05	42	.7	0	4.6
10:30	8.8	1.2	32	1.8	15.0	.05	42	.7	0	4.6
10:40	9	.14	32	1.8	15	.05	42	.7	0	4.5
10:50	9.4	1.2	34	1.8	15	.05	44	.6	0	4.6
pm 11:00	9.4	1.2	34	1.8	15	.05	44	.7	0	4.6

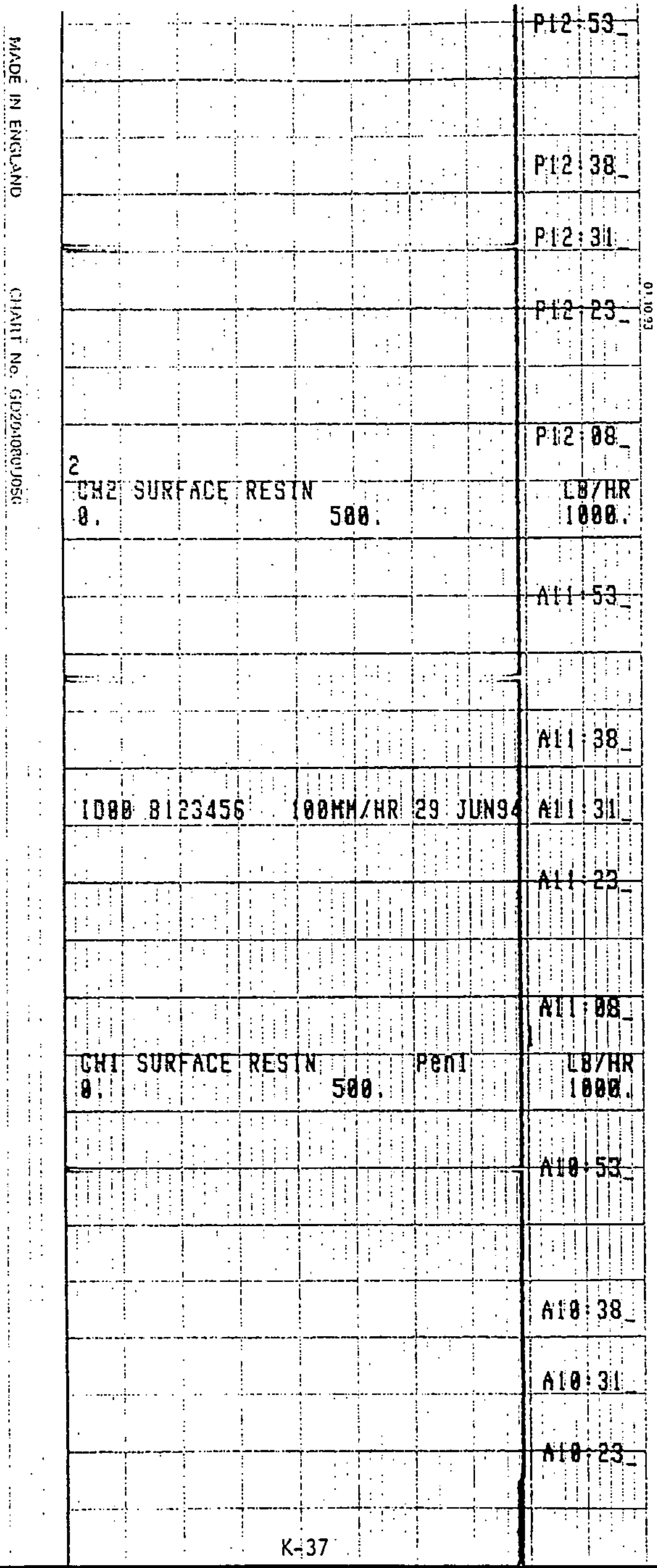
LOUISIANA-PACIFIC CORPORATION
DUNGANNON, VIRGINIA

MOISTURE CONTENT

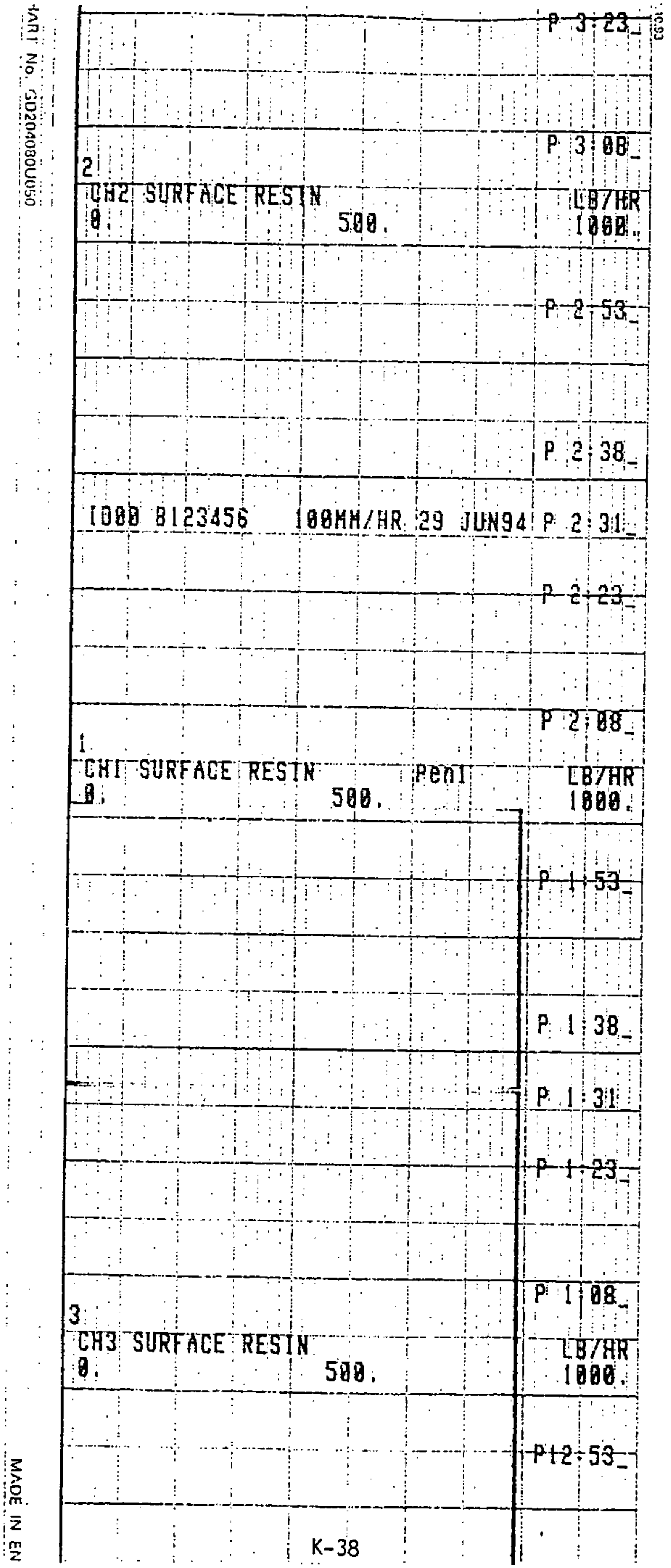
DATE	TIME	WET FLAKE %	DRY FLAKE %	KONUS FUEL %	NAME
6/28/94	8:05	38.2	7.8	38.1	Connie Johnson
6/28/94	9:05	49.9	8.5	38.6	Connie Johnson
6/28/94	10:04	42	8.3	37.2	Connie Johnson
6/28/94	11:05	39.4	7.7	40.7	Connie Johnson
6/28/94	12:00	42.9	8.2	45.3	Connie Johnson
6/28/94	1:00	44.9	7.2	42.1	C. Johnson
6/28/94	2:00	45.3	7.5	41.9	C. Johnson
6/28/94	3:00	45.8	6.3	37.6	C. Johnson
6/28/94	4:00	45.3	7.9	42.7	C. Johnson
6/28/94	5:00	46.3	6.1	39.8	C. Johnson
6/28/94	6:00	51.1	8.7	39.6	C. Johnson
6/28/94	7:00	49.6	8.4	42.1	JF
6/28/94	8:00				



SETTING RESIN FOR TEST


MADE IN ENGLAND
CHART No. GD2010801J05G
01.10.93
P12 53_
P12 38_
P12 31_
P12 23_
P12 08_
2
CH2 SURFACE RESIN
0.
500.
LB/HR
1000.
A11 53_
A11 38_
ID00 0123456
100MM/HR 29 JUN94
A11 31_
A11 23_
A11 08_
CH1 SURFACE RESIN
Pen1
0.
500.
LB/HR
1000.
A10 53_
A10 38_
A10 31_
A10 23_

36



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10.93
P 3:23
P 3:08
2
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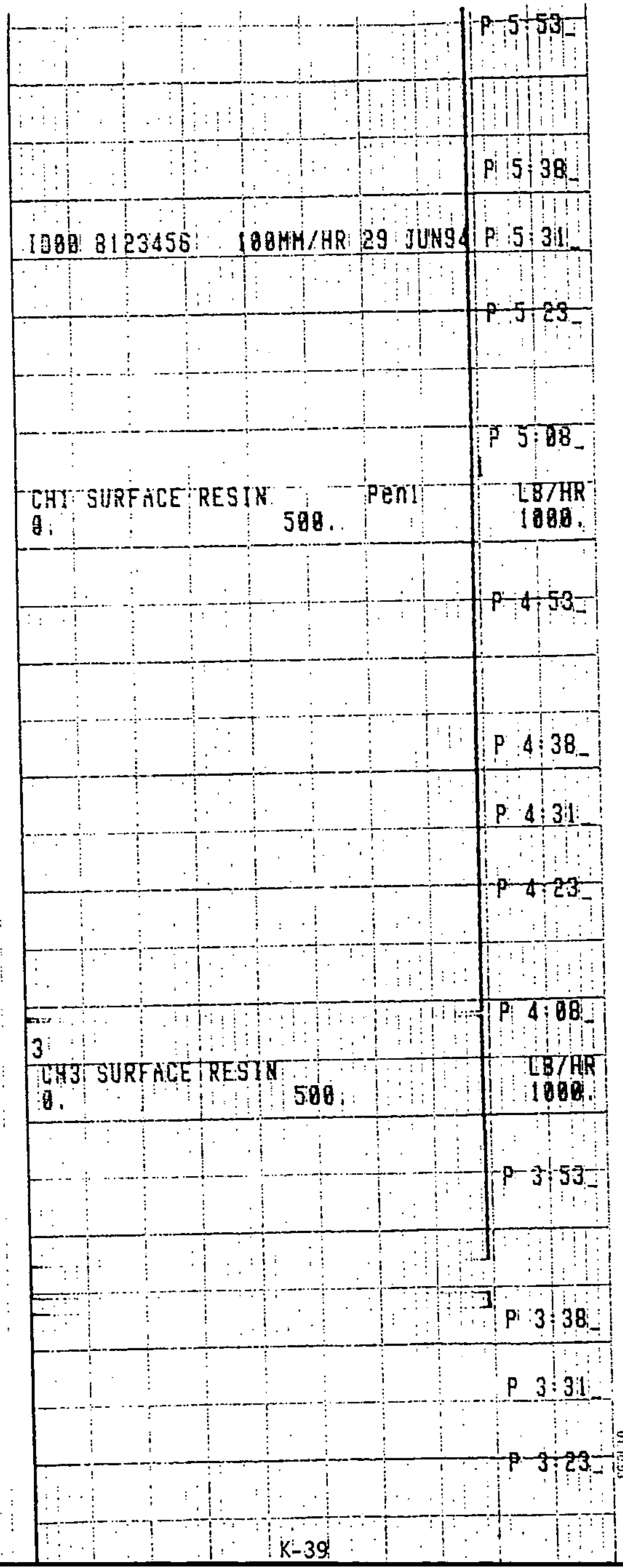
0.
500.
LB/HR
1000.
P 2:53
P 2:38
1000 8123456 100MM/HR 29 JUN94
P 2:31
P 2:23
P 2:08
1
CH1 SURFACE RESIN
Pen1
0.
500.
LB/HR
1000.
P 1:53
P 1:38
P 1:31
P 1:23
P 1:08
3
CH3 SURFACE RESIN
0.
500.
LB/HR
1000.
P12:53
MADE IN EN

37


P 5:53
P 5:38
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P 5:31
P 5:23
P 5:08
CH1 SURFACE RESIN Pen1 LB/HR
0. 500. 1000.
P 4:53
P 4:38
P 4:31
P 4:23
P 4:08
3
CH3 SURFACE RESIN LB/HR
0. 500. 1000.
P 3:53
P 3:38
P 3:31
P 3:23
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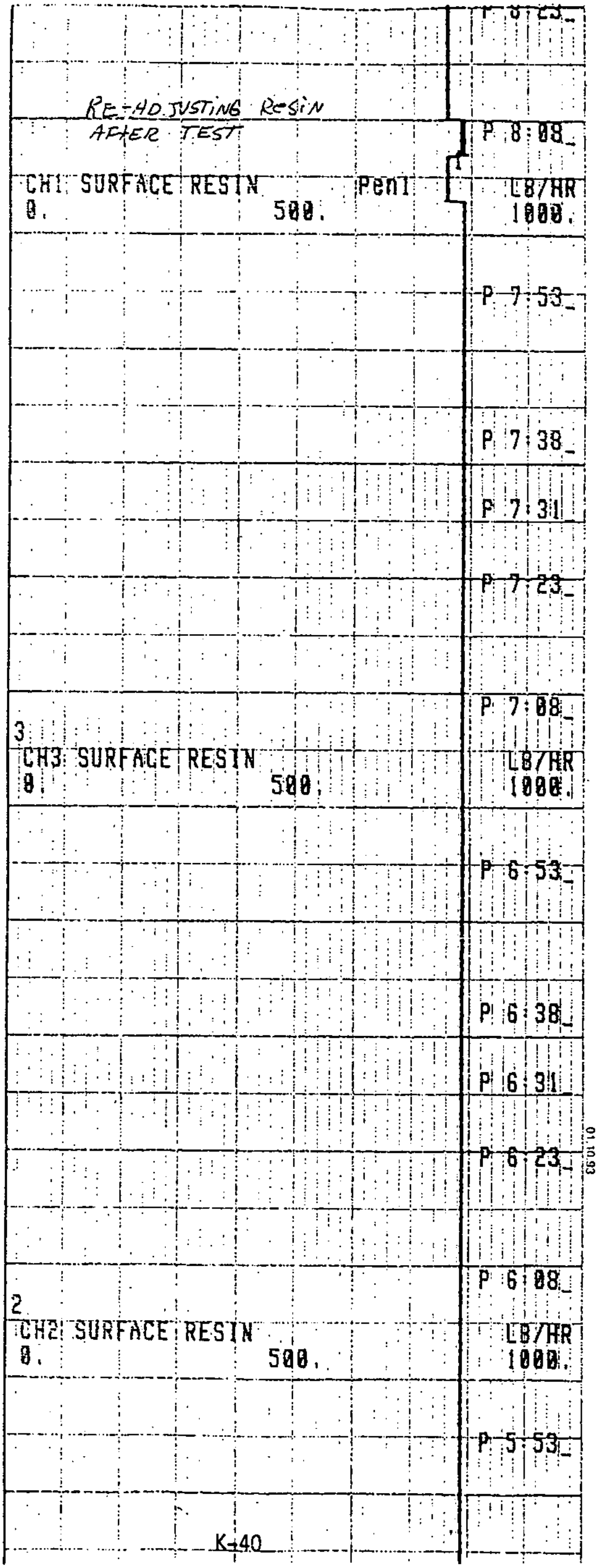
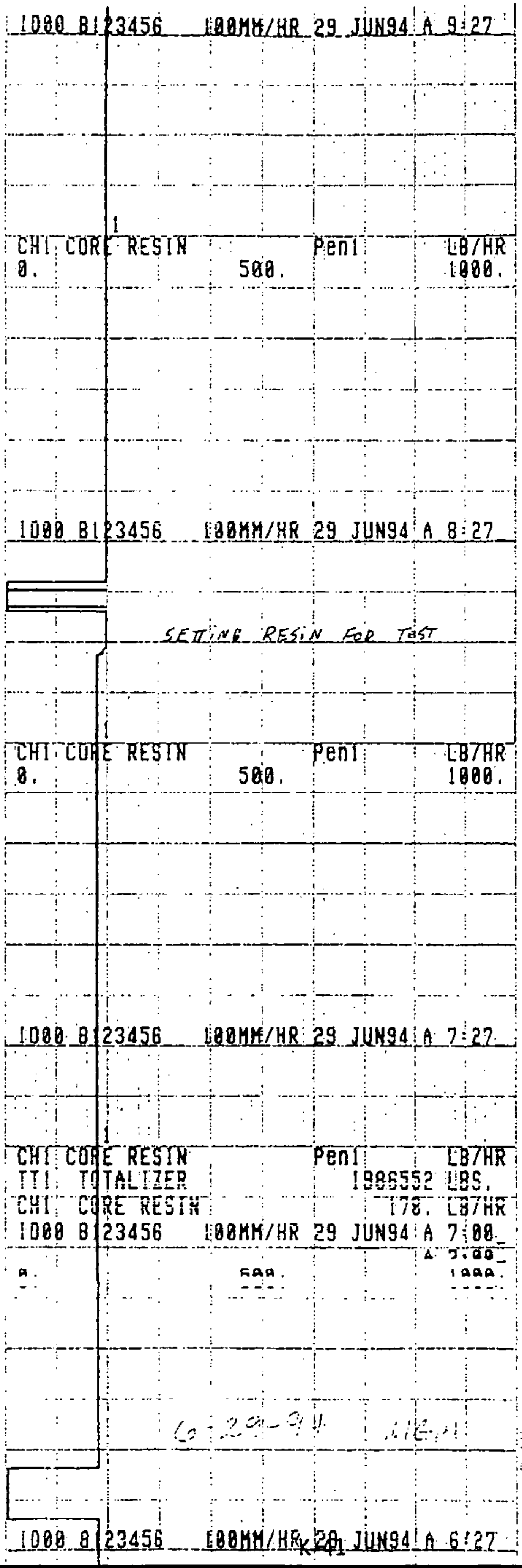


RE-ADJUSTING RESIN
AFTER TEST

39



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I000 B123456   100MM/HR 29 JUN94 A 9:27
                1
CH1 CORE RESIN            Pen1          LB/HR
0.                500.                  1000.
I000 B123456   100MM/HR 29 JUN94 A 8:27
```

SETTING RESIN FOR TEST

```
               1
CH1 CORE RESIN            Pen1          LB/HR
0.                500.                  1000.
I000 B123456   100MM/HR 29 JUN94 A 7:27
               1
CH1 CORE RESIN            Pen1          LB/HR
TT1  TOTALIZER               1986552 LBS.
CH1  CORE RESIN                 178. LB/HR
I000 B123456   100MM/HR 29 JUN94 A 7:00
                                   A 7:00
0.                500.                  1000.
```

6-29-94

```
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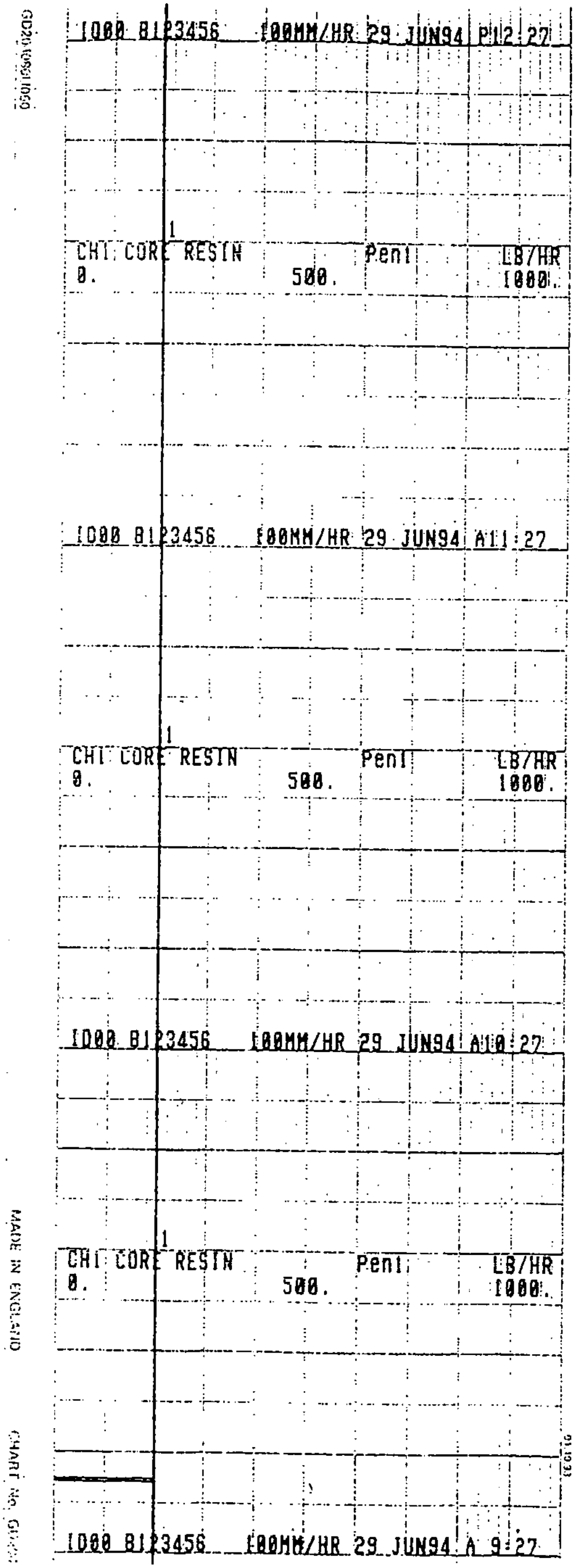
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1
CH1 CORE RESIN Pen1 LB/HR
0. 500. 1000.
ID00 8123456 100MM/HR 29 JUN94 A11:27
1
CH1 CORE RESIN Pen1 LB/HR
0. 500. 1000.
ID00 8123456 100MM/HR 29 JUN94 A10:27
1
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0. 500. 1000.
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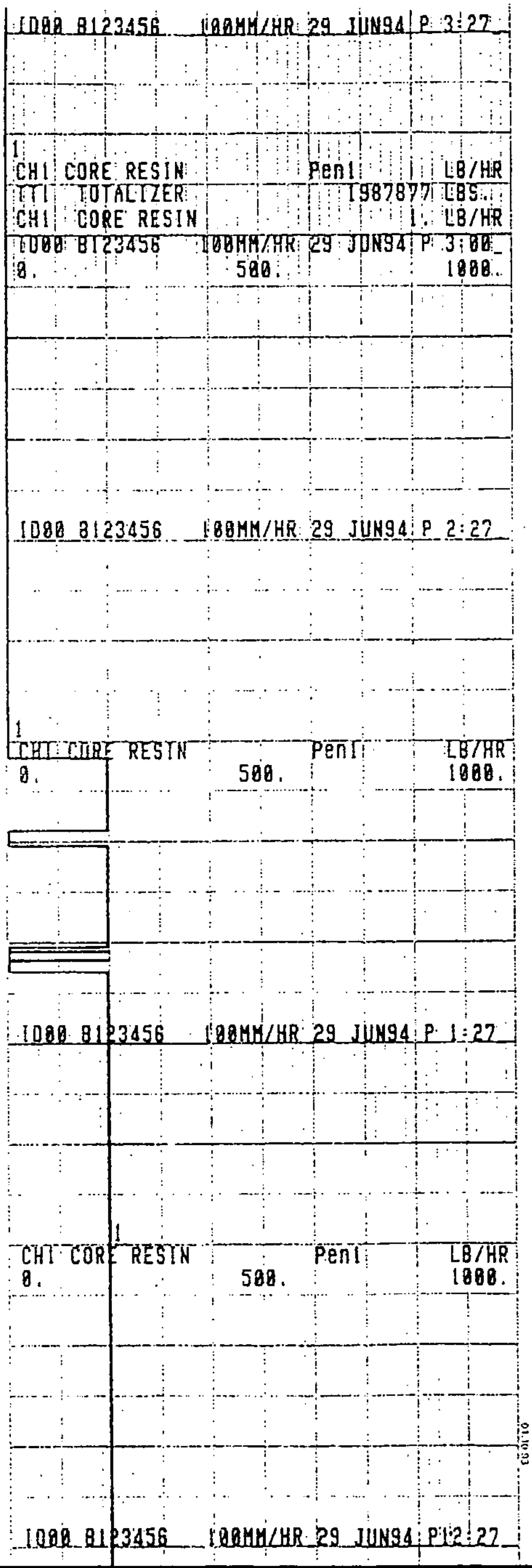
CHART No.

K-42

41



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ID00 8123456    100MM/HR 29 JUN94 P 3:27

1
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TT1  TOTALIZER                1987877 LBS.
CH1  CORE RESIN                     1. LB/HR
ID00 8123456    100MM/HR 29 JUN94 P 3:00
0.              500.                1000.

ID00 8123456    100MM/HR 29 JUN94 P 2:27

1
CH1 CORE RESIN              Pen1        LB/HR
0.              500.                1000.

ID00 8123456    100MM/HR 29 JUN94 P 1:27

1
CH1 CORE RESIN              Pen1        LB/HR
0.              500.                1000.

ID00 8123456    100MM/HR 29 JUN94 P12:27
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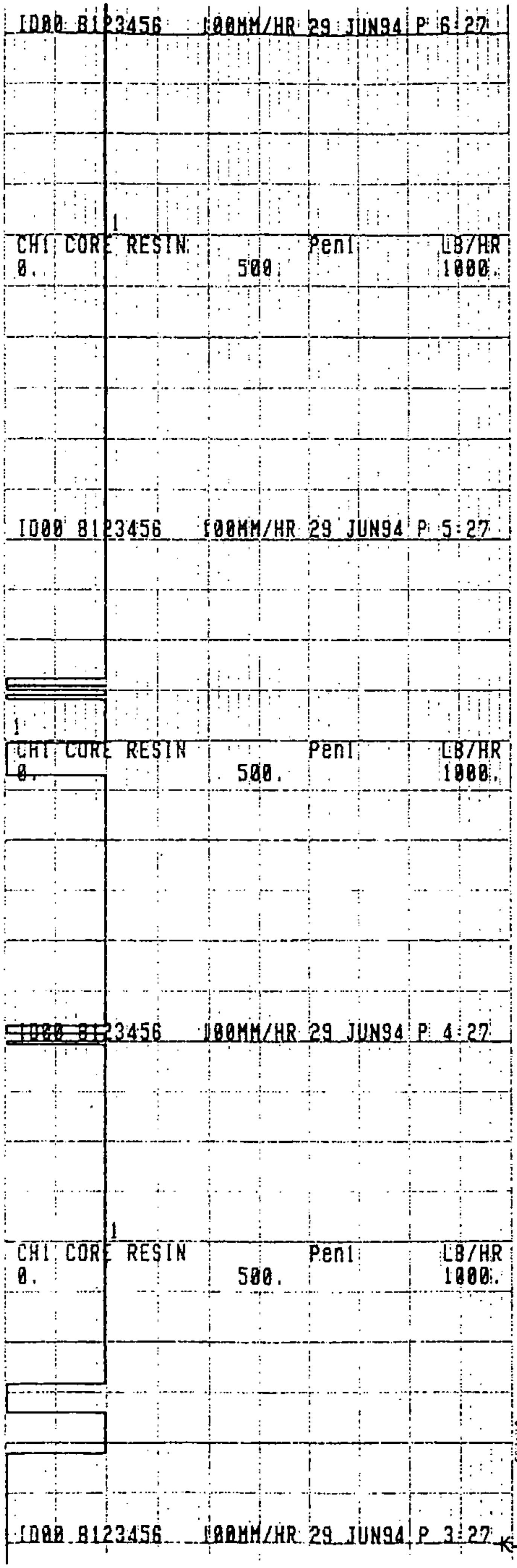
MADE IN ENGLAND

42

K-43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CH1 CORE RESIN Pen1 LB/HR
0. 500. 1000.
ID00 8123456 100MM/HR 29 JUN94 P 5:27
CH1 CORE RESIN Pen1 LB/HR
0. 500. 1000.
ID00 8123456 100MM/HR 29 JUN94 P 4:27
CH1 CORE RESIN Pen1 LB/HR
0. 500. 1000.
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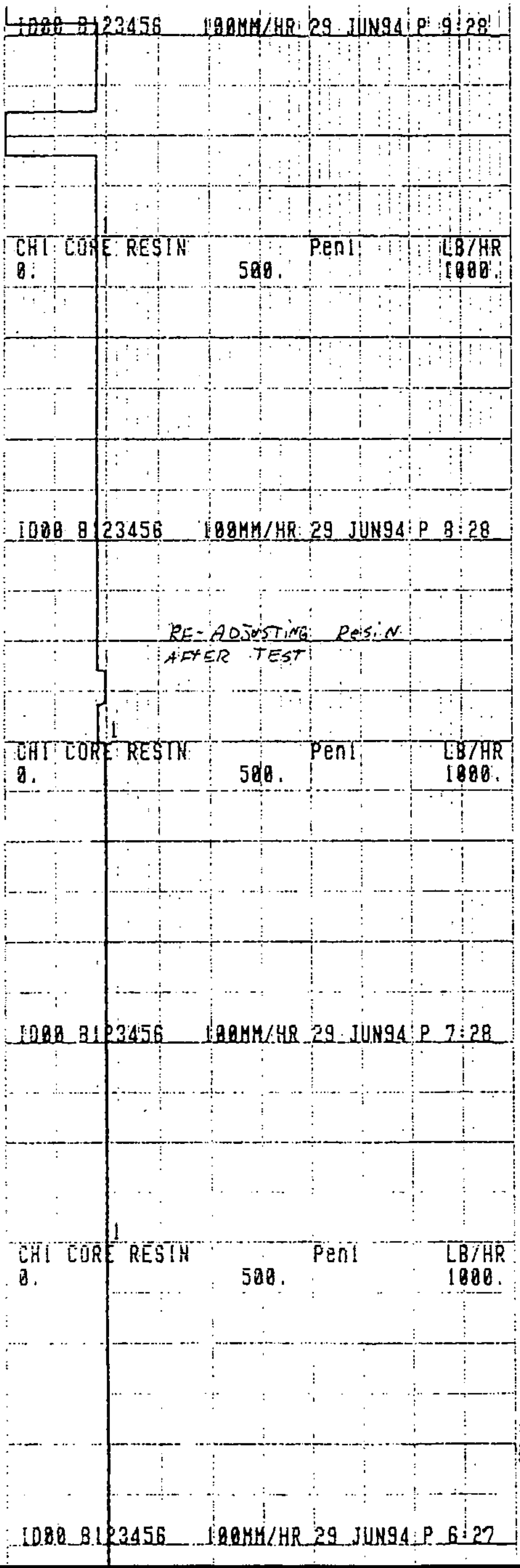
MADE IN ENGLAND
CHART No.

K-44

43



RE-ADJUSTING RESIN
AFTER TEST

44

APPENDIX L

PROCEDURES

Particulate Loading and Emission Rates

The particulate emission rates were determined per EPA Methods 1 - 5, CFR Title 40, Part 60, Appendix A (revised July 1, 1992). In this procedure a preliminary velocity profile of the gases in the flue is obtained by means of a temperature and velocity traverse. On the basis of these values, sampling nozzles of appropriate diameter are selected to allow isokinetic sampling, a necessary prerequisite for obtaining a representative sample.

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

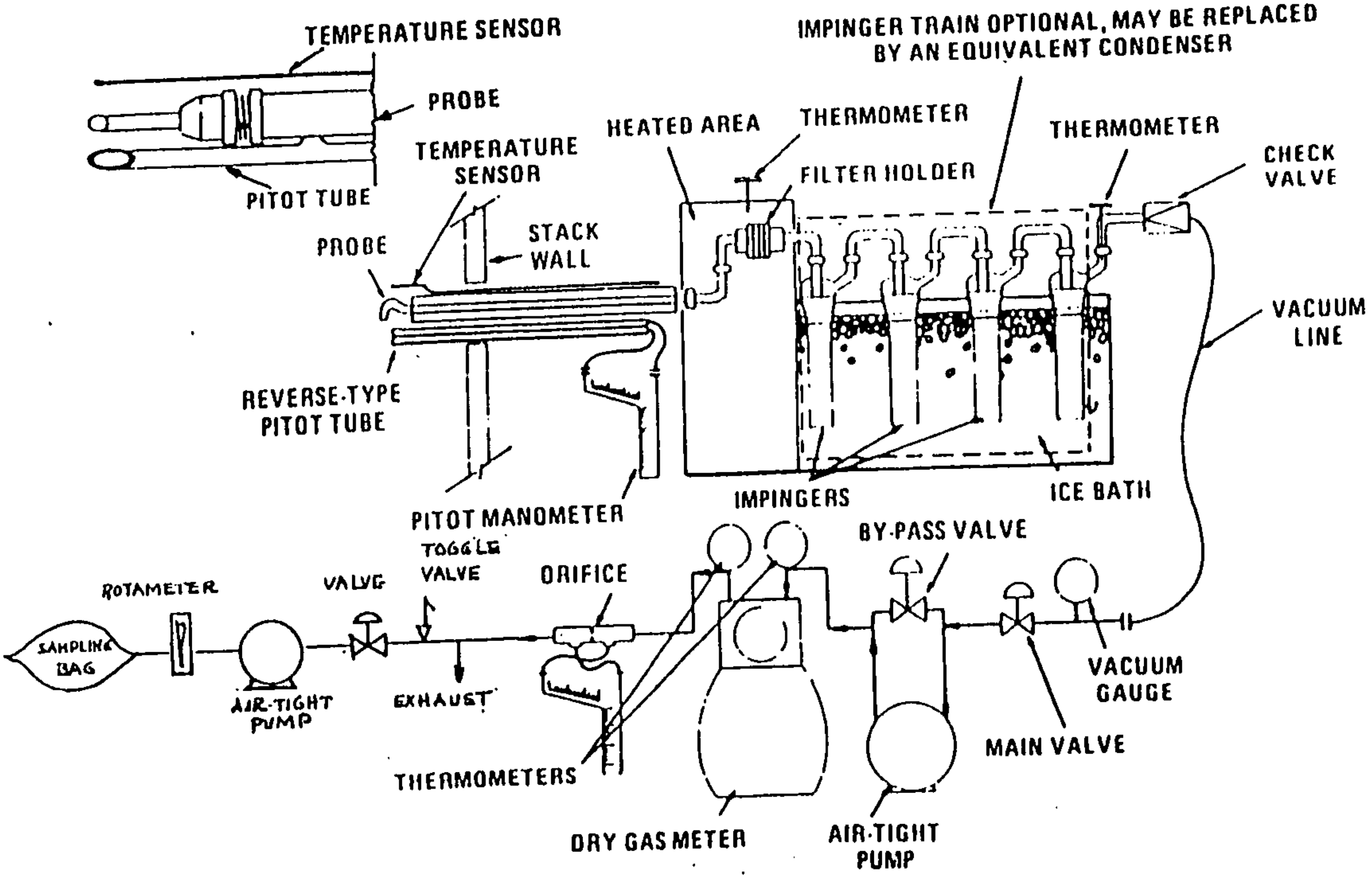
Particulate samples are collected as follows: The sample gas is drawn through the sampling probe isokinetically and passed through a 4-inch diameter Gelman Type A/E glass fiber filter where particulates are removed. The sample gas is then passed through an ice-cooled impinger train and a desiccant-packed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

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

Particulate Loading and Emission Rates

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

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



Particulate-sampling train.

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 51

[AD-FRL-3977-4]

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

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

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

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

EFFECTIVE DATE: December 17, 1991.

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

Docket. Docket No. A-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 Sorrell or Peter Westlin, Emission Measurement Branch (MD-19), Technical Support Division, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, telephone number (919) 541-1064.

SUPPLEMENTARY INFORMATION:

I. The Rulemaking

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

II. Public Participation

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

III. Significant Comments and Changes to the Proposed Rulemaking

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

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

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

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

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

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

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

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

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

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

The EPA agrees that a violation must be shown, in the first instance, by means of measurements made with the applicable test method. Once such a showing is made, however, section 113(e) of the Clean Air Act allows the Agency to rely on any credible evidence, including evidence other than the applicable test method, to establish the duration of the period of noncompliance for the purposes of assessing a penalty.

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

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

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

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

Another commenter suggests that the method should be revised to give credit for ammonium sulfate ($(NH_4)_2SO_3$) dihydrte and other condensible particulate matter formed in the gas stream due to ammonia (NH_3) injection used to enhance the efficiency of a control device.

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

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

The EPA investigated the effectiveness of a chloroform-ether extraction during the method development phase. The chloroform-ether was not as effective as the MeCl in removing organic materials; howeve 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 $(NH_4)_2SO_4$ 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 $(NH_4)_2SO_4$ 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 (⅜-inch) plastic tubing and compression fittings in conjunction with an adjustable pressure regulator and needle valve may be used.

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

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

3.3.1 Separatory Funnel. Glass, 1-liter.

3.3.2 Weighing Tins. 350-ml.

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

3.3.4 Pipets. 5-ml.

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

4. Reagents

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

4.1 Sampling. Same as in Method 17, section 3.1, with the addition of deionized distilled water to conform to the American Society for Testing and Materials Specification D 1193–74, Type II and the omittance 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 $\Delta H_@$ 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. Redissovle 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-77B),
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_{cpm} = 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_b = Sum of the mass of the water and $MeCl_2$ blanks, mg.
m_c = Mass of the NH_4^+ added to sample to form ammonium sulfate, mg.
m_i = Mass of inorganic CPM matter, mg.
m_o = Mass of organic CPM, mg.
m_r = Mass of dried sample from inorganic fraction, mg.
V_a = 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.

$$m_c = K\, C_{SO_4}\, V_{ic} \qquad \text{Eq. 202-1}$$

where:

K = 0.0205, when correcting for NH_4^+ and H_2O.
= 0.1840, when only correcting for NH_4^+.

7.3 Mass of Inorganic CPM.

$$m_i = m_r \frac{V_{ic}}{V_{ic} - V_a} - m_c \qquad \text{Eq. 202-2}$$

7.4 Concentration of CPM.

$$C_{cpm} = \frac{m_o + m_i - m_b}{V_{m(std)}} \qquad \text{Eq. 202-3}$$

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.

$$CSO_4 = \frac{48.03\, V_t\, N}{100} \qquad \text{Eq. 202-4}$$

where

N = Normality of the NH_4OH, mg/ml.
V_t = Volume of NH_4OH titrant, ml.
48.03 = mg/meq.
100 = Volume of solution, ml.

8.3.1 Calculate the CPM as described in section 7.

8.2 Analysis of Chlorides by IC. At the conclusion of the final weighing as described in section 5.3.2.3, redissolve the inorganic fraction in 100 ml of water. Analyze an aliquot of the redissolved sample for chlorides by IC using techniques similar to those described in Method 5F for sulfates. Previous drying of the sample should have removed all HCl. Therefore, the remaining chlorides measured by IC can be assumed to be NH_4Cl, and this weight can be subtracted from the weight determined for CPM.

8.3 Air Purge to Remove SO_2 *from* Impinger Contents. As an alternative to the post-test N_2 purge described in section 5.2.1, the tester may opt to conduct the post-test purge with air at 20 liter/min. Note: The use of an air purge is not as effective as a N_2 purge.

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

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

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

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

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

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

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

8.5.3 Calculate the Concentration of CPM as follows:

$$C_{cpm} = \frac{m_o + m_i + m_f - m_b}{V_{m(std)}} \qquad \text{Eq. 202-5}$$

where:

m_f = 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

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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, 1960.

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

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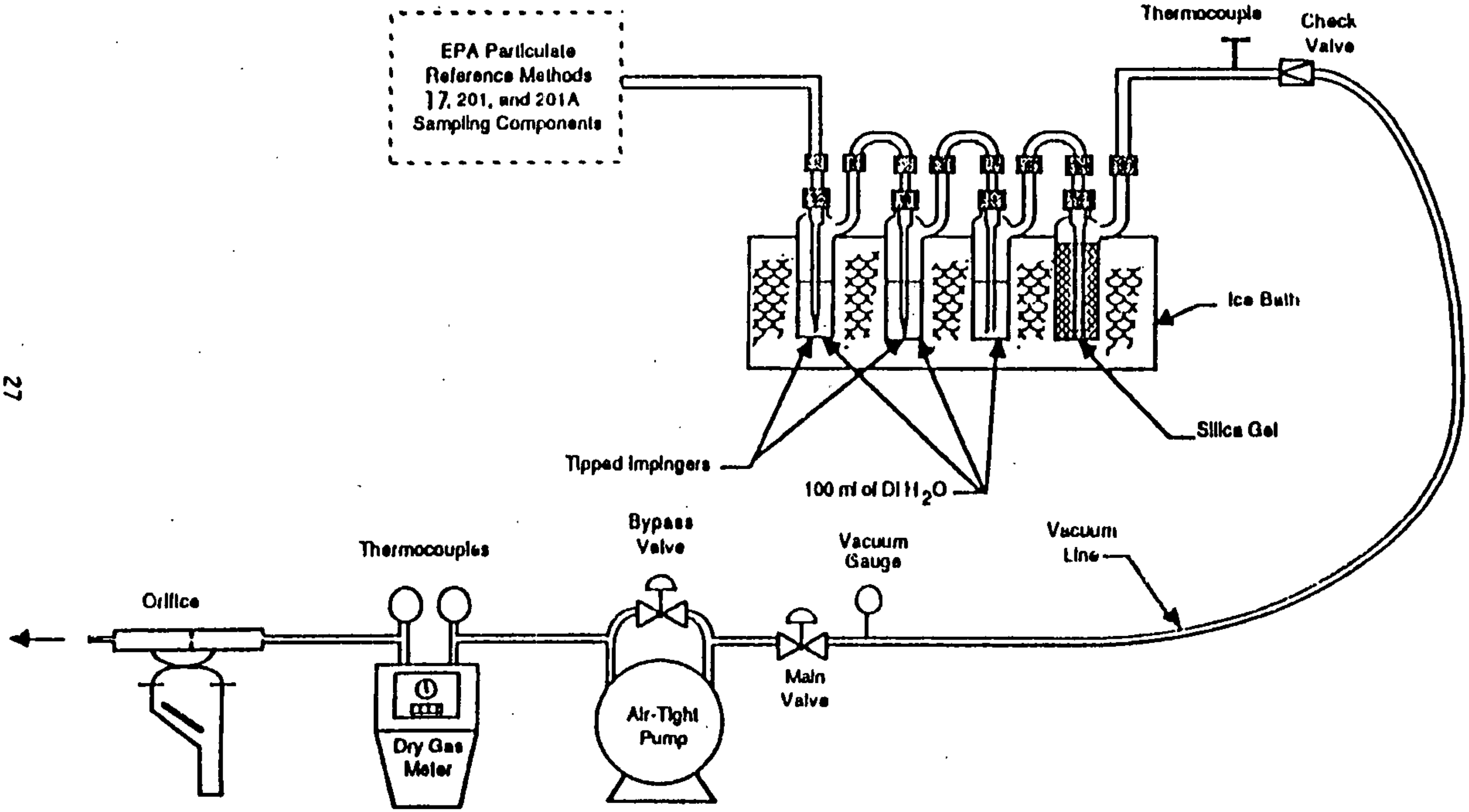

Figure 202-1. , Schematic of condensible particulate sampling train.

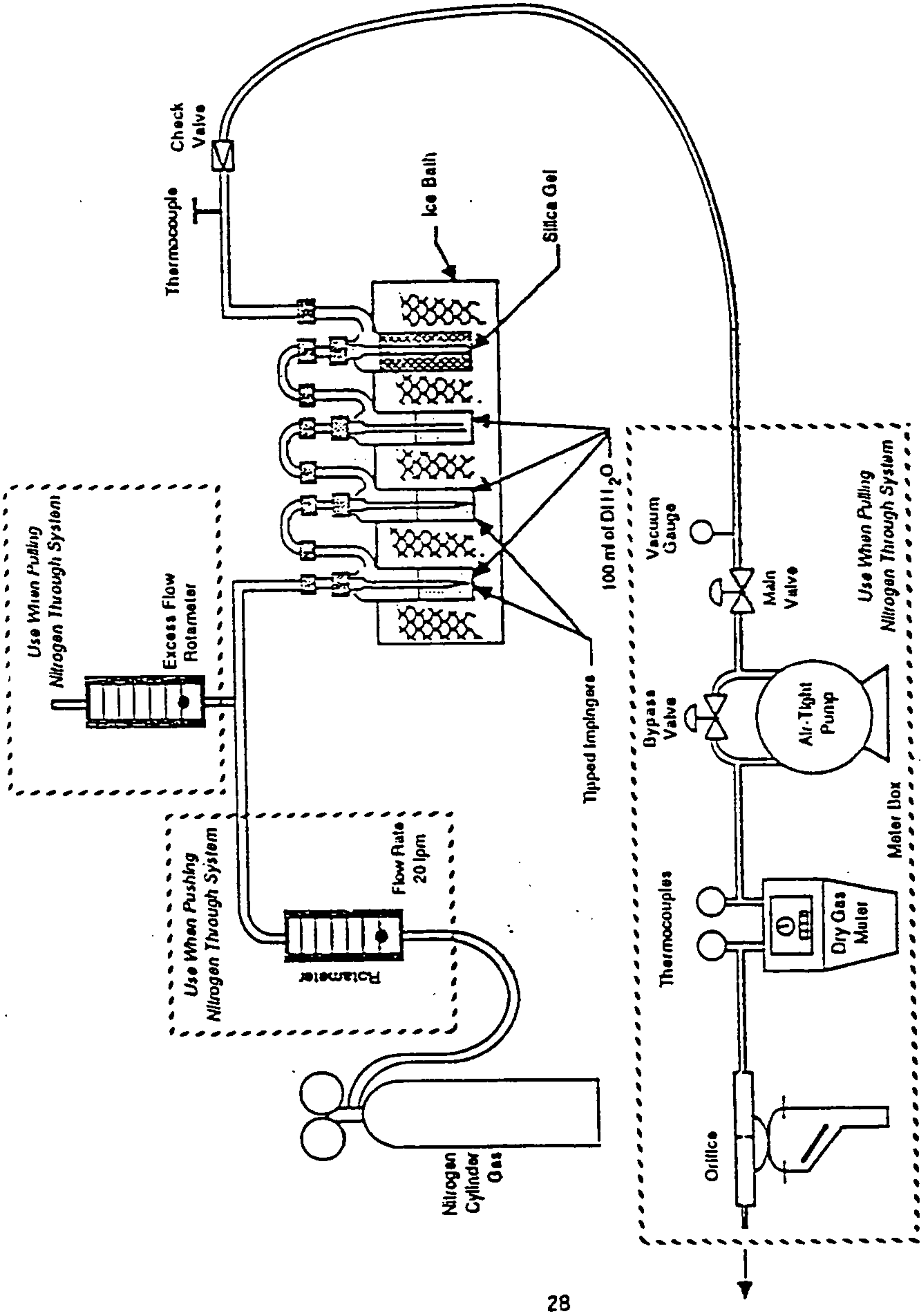

Figure 202-2. Schematic of post-test nitrogen purge system.

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

Total: ________

Less Blank: ________

Weight of Consensible Particulate: ________

Figure 202-3. Analytical data sheet.

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Flow

Flow determinations were carried out in accordance with EPA Method 2, CFR Title 40, Part 60, Appendix A (Revised July 1, 1987). A type S pitot was used to sense velocity pressure and an inclined manometer was used to measure velocity pressures. Gas temperatures were measured using a calibrated Type K thermocouple and digital temperature meter. Gas density (i.e. molecular weight) was calculated from the composition of the gas which was determined by Orsat.

Gas Flow Density

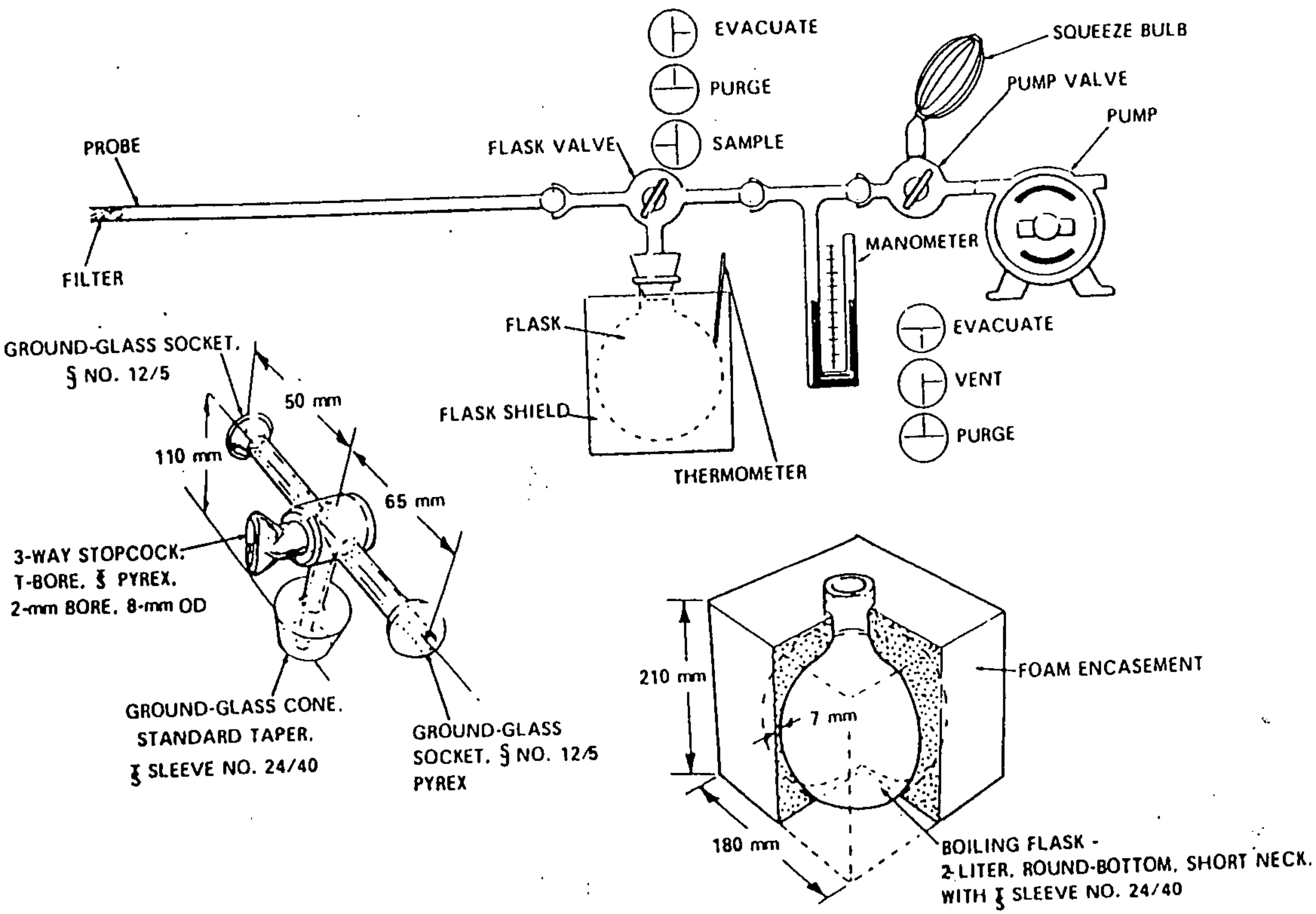
Gas compositions were determined as per Method 3 by Orsat analysis of an integrated gas sample collected from the stack during the oxides of nitrogen determinations. Standard commercially prepared solutions were used in the Orsat analyzer (sat. KOH for carbon dioxide and reduced methylene blue for oxygen).

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.

METHOD 7E—DETERMINATION OF NITROGEN OXIDES EMISSIONS FROM STATIONARY SOURCES (INSTRUMENTAL ANALYZER PROCEDURE)

1. *Applicability and Principle*

1.1 Applicability. This method is applicable to the determination of nitrogen oxides (NO_x) concentrations in emissions from stationary sources only when specified within the regulations.

1.2 Principle. A gas simple is continuously extracted from a stack, and a portion of the sample is conveyed to an instrumental chemiluminescent analyzer for determination of NO_x concentration. Performance specifications and test procedures are provided to ensure reliable data.

2. *Range and Sensitivity*

Same as Method 6C, Sections 2.1 and 2.2.

3. *Definitions*

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

3.1.1 Sample Interface, Gas Analyzer, and Data Recorder. Same as Method 6C, Sections 3.1.1, 3.1.2, and 3.1.3.

3.1.2 NO_2 to NO Converter. A device that converts the nitrogen dioxide (NO_2) in the sample gas to nitrogen oxide (NO).

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

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

4. *Measurement System Performance Specifications*

Same as Method 6C, Sections 4.1 through 4.4.

5. *Apparatus and Reagents*

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

5.1.1 Sample Probe, Sample Line, Calibration Valve Assembly, Moisture Removal System, Particulate Filter, Sample Pump, Sample Flow Rate Control, Sample Gas Manifold, and Data Recorder. Same as Method 6C, Sections 5.1.1 through 5.1.9, and 5.1.11.

5.1.2 NO_2 to NO Converter. That portion of the system that converts the nitrogen dioxide (NO_2) in the sample gas to nitrogen oxide (NO). An NO_2 to NO converter is not necessary if data are presented to demonstrate that the NO_2 portion of the exhaust gas is less than 5 percent of the total NO_x concentration.

5.1.3 NO_x Analyzer. An analyzer based on the principles of chemiluminescence, to determine continuously the NO_x concentration in the sample gas stream. The analyzer shall meet the applicable performance specifications of Section 4. A means of controlling the analyzer flow rate and a device for determining proper sample flow rate (e.g., precision rotameter, pressure gauge downstream of all flow controls, etc.) shall be provided at the analyzer.

5.2 NO_x Calibration Gases. The calibration gases for the NO_x analyzer shall be NO in N_2. Three calibration gases, as specified in Sections 5.3.1 through 5.3.3. of Method 6C, shall be used. Ambient air may be used for the zero gas.

6. *Measurement System Performance Test Procedures*

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

6.1 Calibration Gas Concentration Verification. Follow Section 6.1 of Method 6C, except if calibration gas analysis is required, use Method 7, and change all 5 percent performance values to 10 percent (or 10 ppm, whichever is greater).

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

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

6.4 NO_2 to NO Conversion Efficiency. Unless data are presented to demonstrate that the NO_2 concentration within the sample stream is not greater than 5 percent of the NO_x concentration, conduct an NO_2 to NO conversion efficiency test in accordance with Section 5.6 of Method 20.

7. *Emission Test Procedure*

7.1 Selection of Sampling Site and Sampling Points. Select a measurement site and sampling points using the same criteria that are applicable to tests performed using Method 7.

7.2 Sample Collection. Position the sampling probe at the first measurement point, and begin sampling at the same rate as used during the system calibration drift test. Maintain constant rate sampling (i.e., ±10 percent) during the entire run. The sampling time per run shall be the same as the total time required to perform a run using Method 7, plus twice the system response time. For each run, use only those measurements obtained after twice the response time of the measurement system has elapsed, to determine the average effluent concentration.

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

8. *Emission Calculation*

Follow Section 8 of Method 6C.

9. *Bibliography*

Same as bibliography of Method 6C.

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

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

5. *References*

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

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

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

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

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

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

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

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

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

METHOD 10—DETERMINATION OF CARBON MONOXIDE EMISSIONS FROM STATIONARY SOURCES

1. *Principle and Applicability*

1.1 Principle. An integrated or continuous gas sample is extracted from a sampling point and analyzed for carbon monoxide (CO) content using a Luft-type nondispersive infrared analyzer (NDIR) or equivalent.

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

2. *Range and Sensitivity*

2.1 Range. 0 to 1,000 ppm.

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

3. *Interferences*

Any substance having a strong absorption of infrared energy will interfere to some extent. For example, discrimination ratios for water (H_2O) and carbon dioxide (CO_2) are 3.5 percent H_2O per 7 ppm CO and 10 percent CO_2 per 10 ppm CO, respectively, for devices measuring in the 1,500 to 3,000 ppm range. For devices measuring in the 0 to 100 ppm range, interference ratios can be as high as 3.5 percent H_2O per 25 ppm CO and 10 percent CO_2 per 50 ppm CO. The use of silica gel and ascarite traps will alleviate the major interference problems. The measured gas volume must be corrected if these traps are used.

4. *Precision and Accuracy*

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

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

5. *Apparatus*

5.1 Continuous Sample (Figure 10-1).

5.1.1 Probe. Stainless steel or sheathed Pyrex[1] glass, equipped with a filter to remove particulate matter.

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

5.2 Integrated Sample (Figure 10-2).

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

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

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

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

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

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

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

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

5.3 Analysis (Figure 10-3).

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

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

5.3.3 Calibration Gas. Refer to section 6.1.

5.3.4 Filter. As recommended by NDIR manufacturer.

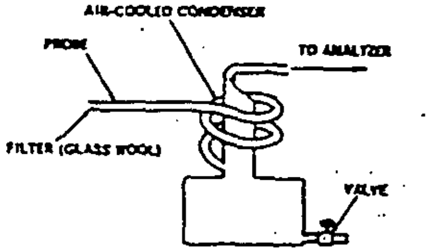

Figure 10-1. Continuous sampling train.

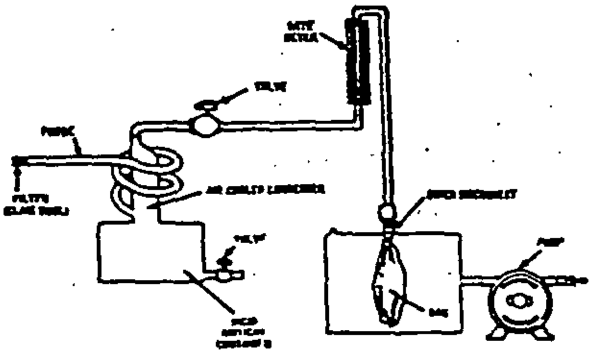

Figure 10-2. Integrated gas sampling train.

5.3.5 CO_2 Removal Tube. To contain approximately 500 g of ascarite.

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

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

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

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

6. *Reagents*

6.1 Calibration Gases. Known concentration of CO in nitrogen (N_2) for instrument span, prepurified grade of N_2 for zero, and two additional concentrations corresponding approximately to 60 percent and 30 percent span. The span concentration shall not exceed 1.5 times the applicable source performance standard. The calibration gases shall be certified by the manufacturer to be within ±2 percent of the specified concentration.

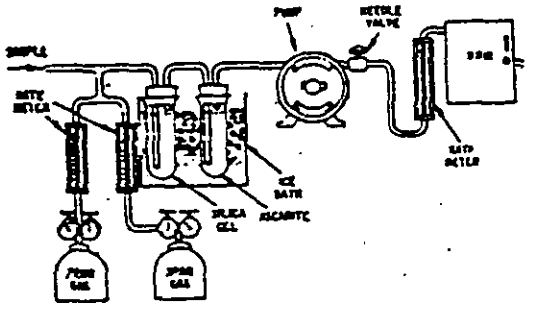

Figure 10-3. Analytical equipment.

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

6.3 Ascarite. Commercially available.

7. *Procedure*

7.1 Sampling.

7.1.1 Continuous Sampling. Set up the equipment as shown in Figure 10-1 making sure all connections are leak free. Place the probe in the stack at a sampling point and purge the sampling line. Connect the analyzer and begin drawing sample into the analyzer. Allow 5 minutes for the system to stabilize, then record the analyzer reading as required by the test procedure. (See section 7.2 and 8). CO_2 content of the gas may be determined by using the Method 3 integrated sample procedure, or by weighing the ascarite CO_2 removal tube and computing CO_2 concentration from the gas volume sampled and the weight gain of the tube.

7.1.2 Integrated Sampling. Evacuate the flexible bag. Set up the equipment as shown in Figure 10-2 with the bag disconnected. Place the probe in the stack and purge the sampling line. Connect the bag, making sure that all connections are leak free. Sample at a rate proportional to the stack velocity. CO_2 content of the gas may be determined by using the Method 3 integrated sample procedures, or by weighing the ascarite CO_2 removal tube and computing CO_2 concentration from the gas volume sampled and the weight gain of the tube.

7.2 CO Analysis. Assemble the apparatus as shown in Figure 10-3, calibrate the instrument, and perform other required operations as described in section 8. Purge analyzer with N_2 prior to introduction of each sample. Direct the sample stream through the instrument for the test period, recording the readings. Check the zero and span again after the test to assure that any drift or malfunction is detected. Record the sample data on Table 10-1.

8. *Calibration*

Assemble the apparatus according to Figure 10-3. Generally an instrument requires a warm-up period before stability is obtained. Follow the manufacturer's instructions for specific procedure. Allow a minimum time of 1 hour for warm-up. During this time check the sample conditioning apparatus, i.e., filter, condenser, drying tube, and CO_2 removal tube, to ensure that each component is in good operating condition. Zero and calibrate the instrument according to the manufacturer's procedures using, respectively, nitrogen and the calibration gases.

TABLE 10-1—FIELD DATA

	Comments
Location............	
Test............	
Date............	
Operator............	

Clock time	Rotameter setting, liters per minute (cubic feet per minute)

9. *Calculation*

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

$$C_{CO\ stack} = C_{CO\ NDIR}(1 - F_{CO_2})$$

Eq. 10-1

Where:

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

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

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

10. *Alternative Procedures*

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

11. *Bibliography*

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

ADDENDA

A. PERFORMANCE SPECIFICATIONS FOR NDIR CARBON MONOXIDE ANALYZERS

Range (minimum)............	0-1000 ppm.
Output (minimum)............	0-10mV.
Minimum detectable sensitivity.	20 ppm.
Rise time, 90 percent (maximum).	30 seconds.
Fall time, 90 percent (maximum).	30 seconds.
Zero drift (maximum)............	10% in 8 hours.
Span drift (maximum)............	10% in 8 hours.
Precision (minimum)............	±2% of full scale.
Noise (maximum)............	±1% of full scale.
Linearity (maximum deviation).	2% of full scale.
Interference rejection ratio............	CO_2—1000 to 1, H_2O—500 to 1.

B. *Definitions of Performance Specifications.*

Range—The minimum and maximum measurement limits.

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

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

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

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Current as of
3-26-91

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 that 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 assemble 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 μm 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 ~~heads~~ pressure drops (ΔH): one at the average stack temperature, and the other two at temperatures ±28°C (±50°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 Δp_{min} and Δp_{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 Δp_{min} and Δp_{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 °K (51.05 micropoise for °R).

C_2 = Viscosity constant, 0.372 micropoise/°K (0.207 micropoise/°R).

C_3 = Viscosity constant, 1.05×10^{-4} micropoise/°K^2 (3.24×10^{-5} micropoise/°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_0 = Stack gas fraction O_2, by volume, dry basis.

K_1 = 0.3858 °K/mm Hg (17.64 °R/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 (ft^3/min). YES!

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

T_m = Average absolute temperature of dry meter, °K (°R).

T_s = Average absolute stack gas temperature, °K (°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:

$$\mu_s = C_1 + C_2 \cdot T_s + C_3 T_s^2 + C_4 f_{O2} - C_5 B_{ws}$$

No! Use equation on page 24

$V_{w(std)} = .04707(V_f - V_i)$

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

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

$T_s = \bar{t}_s + 460$

but $Q_{s(std)} = \dfrac{V_{m(std)}}{\theta}$

$K_1 = 17.64$

Substituting gives:

$Q_s = \dfrac{5.669 \times 10^{-2}(\bar{t}_s + 460)}{\theta P_s}\left[V_{m(std)} + .04707(\right.$ [illegible]

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 β_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 µm $\leq D_{50} \leq$ 11.0 µm. The second is that no sampling points are outside Δp_{min} and Δp_{max}, or that 80 percent $\leq I \leq$ 120 percent and no more than one sampling point is outside Δp_{min} and Δp_{max}. If D_{50} is less than 9.0 µm, 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 PM_{10} Emissions. Southern Research Institute for the Environmental Protection Agency. April 1989. NTIS PB 89 190375, EPA/600/3-88-056.

4. <u>Application Guide for Source PM_{10} Measurement with Constant Sampling Rate</u>, EPA/600/3-88-057.

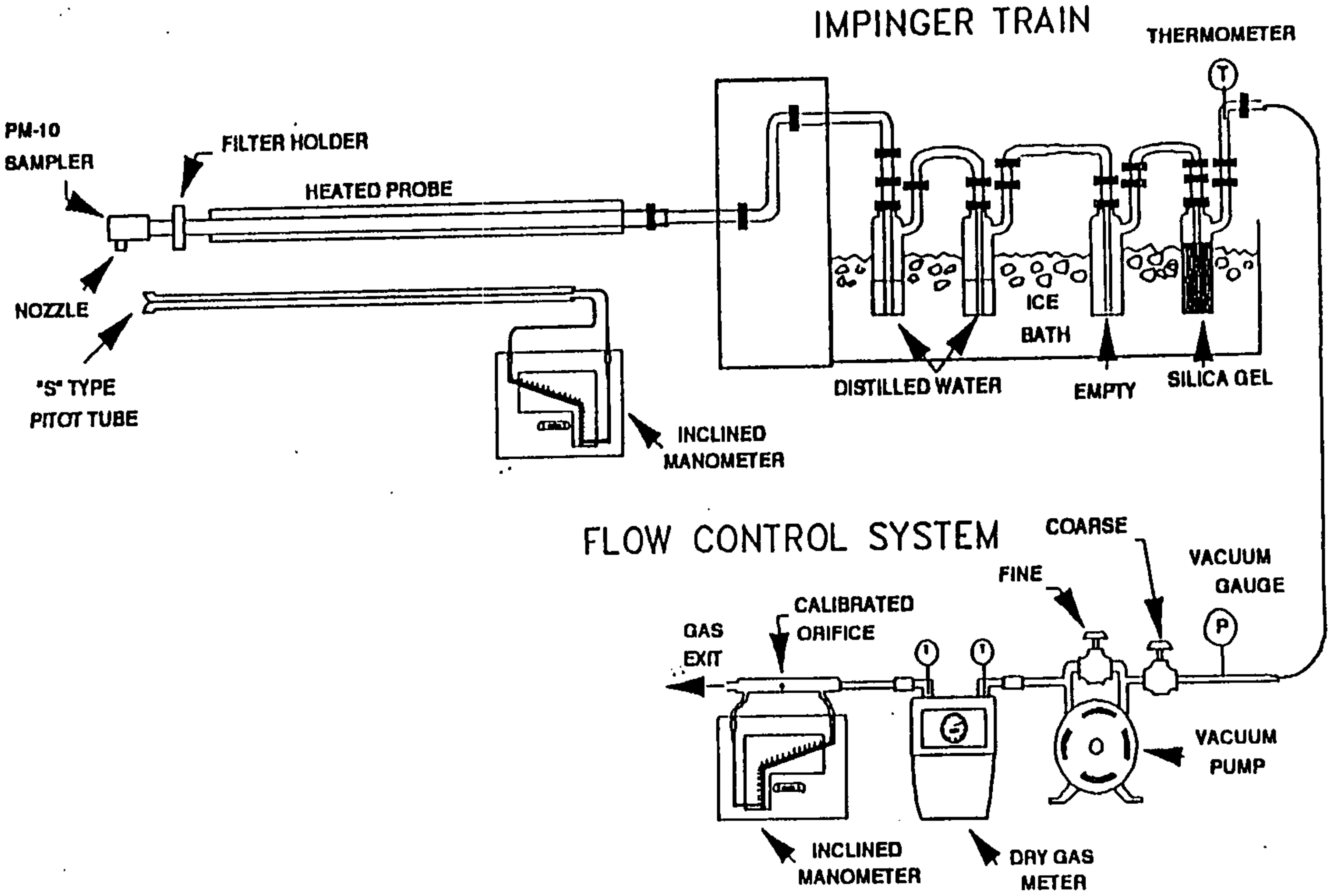
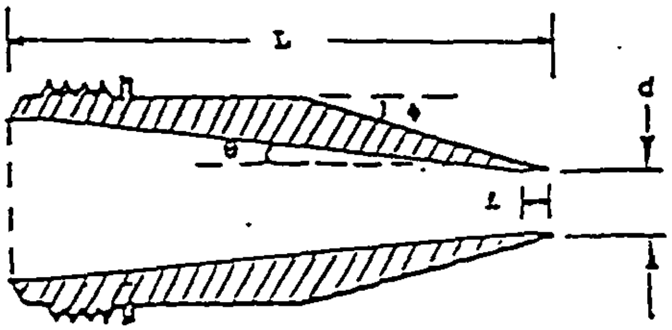


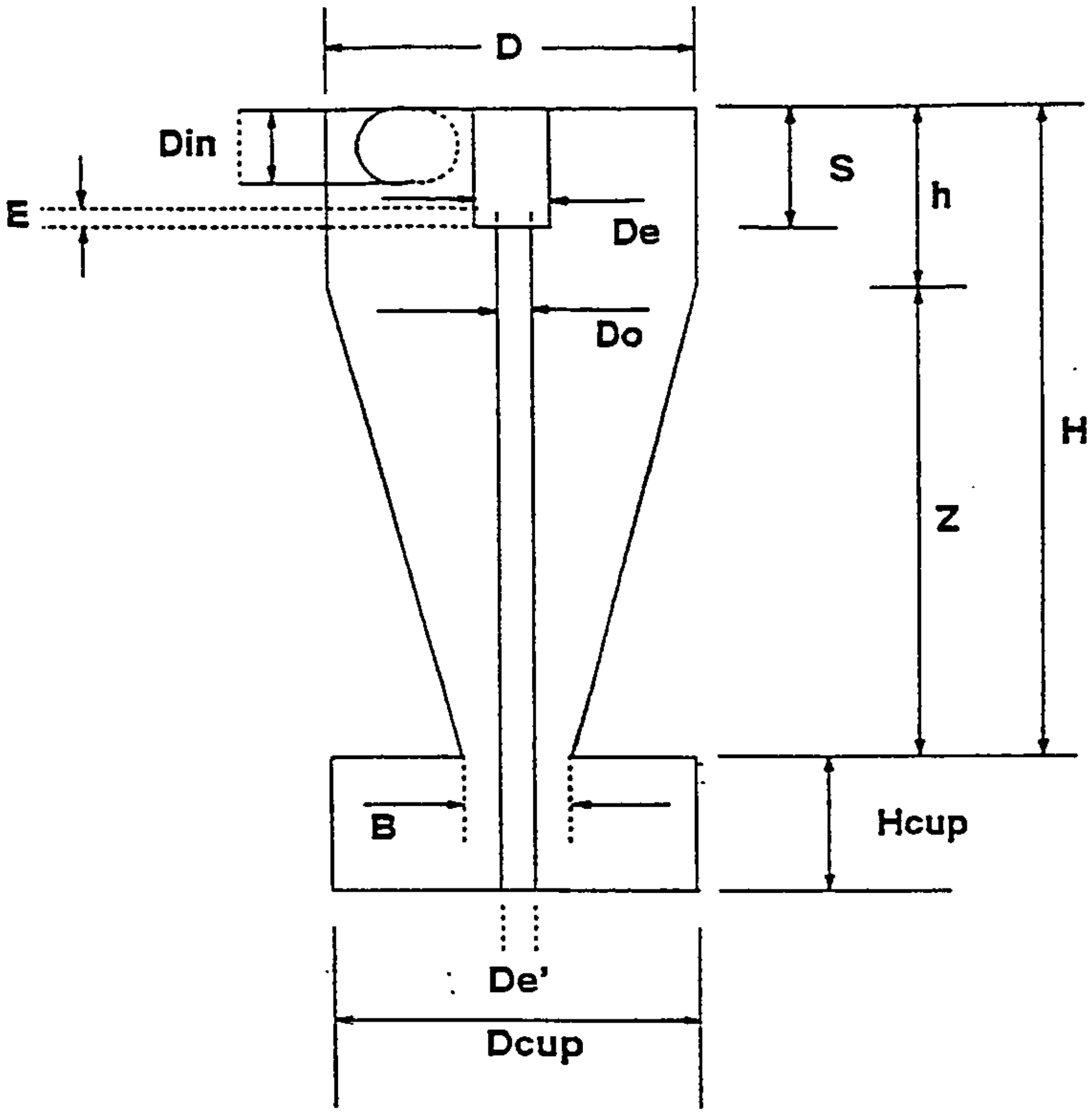
Figure 1. CSR Sampling Train



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_g, in. H_2O = ______________
Average stack temperature, t_s, °F = ______________
Meter temperature, t_m, °F = ______________
Orifice ΔH_a, in. H_2O = ______________

Gas analysis:

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

Molecular weight of stack gas, dry basis:

$$M_d = 0.44(\%CO_2) + .32(\%O_2) + 0.28(\%N_2 + \%CO) = \_\_\_\_\_ \text{ lb/lb mole}$$

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.

note

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

$$\Delta H = \left(\frac{Q_s(1-B_{ws})P_s}{t_s + 460}\right)^2 \frac{(t_m + 460)\ M_d\ (1.083)\ \Delta H_@}{P_{bar}} = \_\_\_\_\_\_ \text{ in. } H_2O$$

Calculate ΔH for three temperatures:

t_s, °F			
ΔH, in. H_2O			

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

$$v_n = \frac{3.056\ Q_s}{D_n^2} = \underline{\hspace{3cm}}\ \text{ft/sec}$$

Maximum and minimum velocities:

Calculate R_{min}.

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

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

Eq. 1 $\quad v_{min} = v_n\ (0.5) = \underline{\hspace{1.5cm}}$ ft/sec

Eq. 2 $\quad v_{min} = v_n\ R_{min} = \underline{\hspace{1.5cm}}$ ft/sec

Calculate R_{max}.

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

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 $v_{max} = v_n\,(1.5) =$ ______ ft/sec

Eq. 4 $v_{max} = v_n\,R_{max} =$ ______ ft/sec

Maximum and minimum velocity head values:

$$\Delta p_{min} = 1.3686 \times 10^{-4}\,\frac{P_s\,M_w\,(v_{min})^2}{(t_s + 460)\,C_p^2} = \_\_\_\_\_ \text{ in. } H_2O$$

$$\Delta p_{max} = 1.3686 \times 10^{-4}\,\frac{P_s\,M_w\,(v_{max})^2}{(t_s + 460)\,C_p^2} = \_\_\_\_\_ \text{ in. } H_2O$$

Nozzle Number				
D_n, in.				
v_n, ft/sec				
v_{min}, ft/sec				
v_{max}, ft/sec				
Δp_{min}, in. H_2O				
Δp_{max}, in. H_2O				

Velocity traverse data:

incorrect

$$\Delta p(\text{Method 201A}) = \xcancel{\Delta p(\text{Method 2})\left[\frac{C_p}{C_p'}\right]^2} = \Delta p^{M2}\left(\frac{C_p^{M2}}{C_p^{201A}}\right)^2$$

4-11-91 PL

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

Total run time, minutes = ____________

Number of traverse points = ____________

$$t_1 = \sqrt{\frac{\Delta p_1'}{\Delta p_{avg}'}} \left(\frac{\text{Total run time}}{\text{Number of points}}\right)$$

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:

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

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 PM10..........	

Figure 7. Method 201A analysis sheet.

TABLE 1. PERFORMANCE SPECIFICATIONS FOR SOURCE PM_{10} 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.

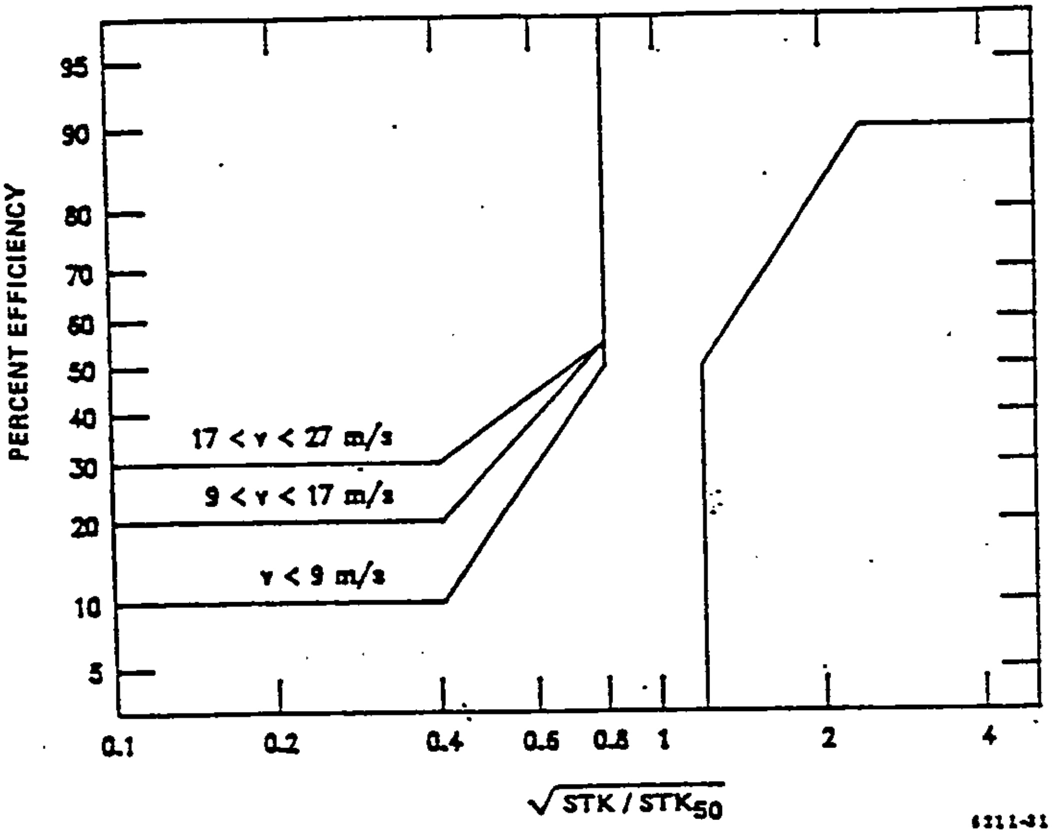


Figure 9. Efficiency envelope for first calibration stage.

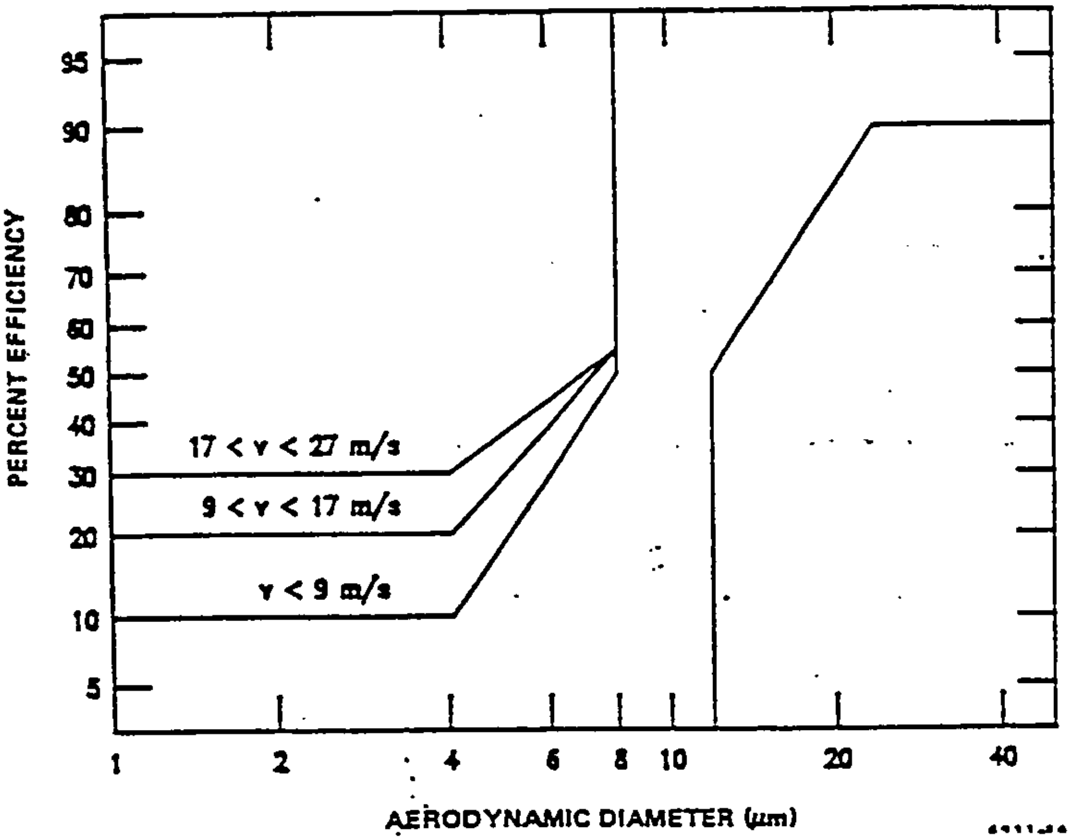


Figure 8. Efficiency envelope for the PM_{10} cyclone.

EPA
METHOD 0011

SAMPLING FOR FORMALDEHYDE EMISSIONS FROM STATIONARY SOURCES

1.0 SCOPE AND APPLICATION

1.1 This method is applicable to the determination of Destruction and Removal Efficiency (DRE) of 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 x 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 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 ± 14°C (248 ± 25°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, µg/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):

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

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 500µL 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 ft^3 of sample volume is required for the determination of the Destruction and Removal Efficiency (DRE) of formaldehyde from incineration systems (45ft^3 is equivalent to one hour of sampling at 0.75 dscf). Additional sample volume shall be collected as ecessitated 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 m^3/min (0.02 cfm), whichever is less, are acceptable.

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

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

6.5.2 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 m^3/min (0.02 cfm) or 4% of the average sampling rate (whichever is less), the results are acceptable. If a higher leakage rate is obtained, the tester must void the sampling run.

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

6.5.2.2 Immediately after a component change and before sampling is 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 m^3/min (0.02 cfm) or 4% of the average sampling rate (whichever is less), the results are acceptable. If, however, a higher leakage rate is obtained, the tester shall record the leakage rate and void the sampling run.

6.6 Sampling Train Operation:

6.6.1 During the sampling run, maintain an isokinetic sampling rate to within 10% of true isokinetic, below 28 L/min (1.0 cfm). Maintain a temperature around the probe of 120° ± 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°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 curing 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 m^3/min (0.02 cfm). At the end of the run, take the difference of the measured wet-test and dry-gas meter volumes and divide the difference by 10 to get the leak rate. The leak rate should not exceed 0.00057 m^3/min (0.02 cfm).

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

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

NOTE: If the dry-gas-meter coefficient values obtained before and after a test series differ by >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 ±2°C (3.6°F) with those of the absolute value of the reference thermometer.

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

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

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

9.0 CALCULATIONS

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

9.1 Calculation of Total Formaldehyde:

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

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

where:

C_d = measured concentration of DNPH-formaldehyde derivative, µg/mL

V = organic extract volume, mL

DF = dilution factor

9.2 Formaldehyde concentration in stack gas:

Determine the formaldehyde concentration in the stack gas using the following equation:

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

where:

K = 35.31 ft^3/m^3 if $V_{m(std)}$ is expressed in English units

= 1.00 m^3/m^3 if $V_{m(std)}$ is expressed in metric units

$V_{m(std)}$ = volume of gas sample as measured by dry gas meter, corrected to standard conditions, dscm (dscf)

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

9.4 Dry Gas Volume: Calculate $V_{m(std)}$ and adjust for leakage, if necessary, using the equation in 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:

$\text{Max FORM}_i \text{ Mass} =$

$[(\text{WF})(\text{FORM}_i \text{ conc})(100 - \%\text{DRE})] / 100$

where:

WF = mass flow rate of waste feed per h, g/h (lb/h)

FORM_i = concentration of FORM (wt %) introduced into the combustion process

DRE = percent Destruction and Removal Efficiency required

Max FORM = mass flow rate (g/h [lb/h]) of FORM emitted from the combustion 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:

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

where:

$DV_{eff(std)}$ = volumetric flow rate of exhaust gas, dscm (dscf)

FORM_i conc = anticipated concentration of the FORM in the exhaust gas stream, g/dscm (lb/dscf)

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

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

where:

LDL_{FORM} = detectable amount of FORM in entire sampling train

V_{tbc} = minimum dry standard volume to be collected at dry-gas meter

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

Table 2. Instrument Detection Limits and Reagent Capacity for Formaldehyde Analysis[1]

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.

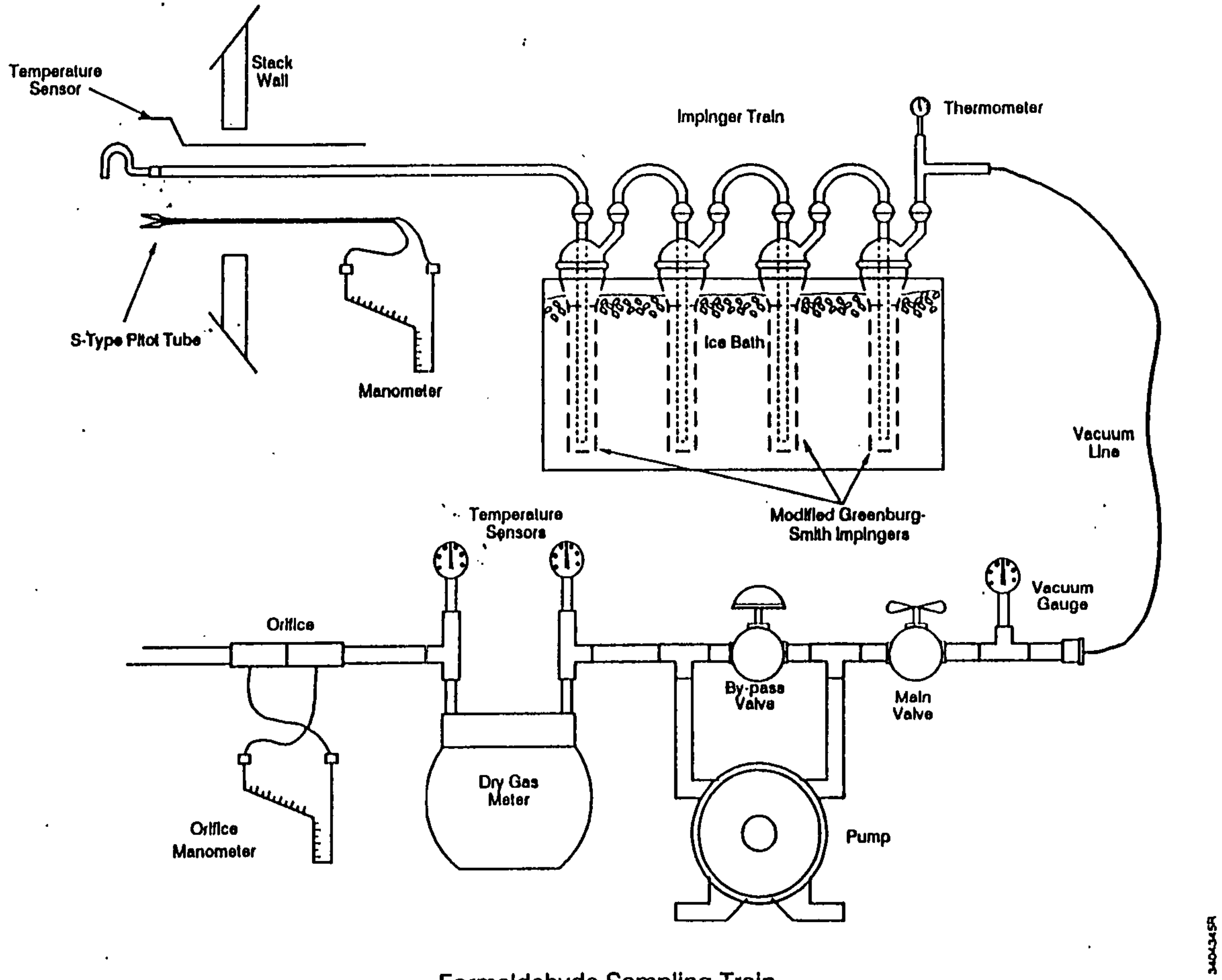
Table 3. Expected Method Performance for Formaldehyde

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

Plant ______

Location ______

Operator ______

Date ______

Run No. ______

Sample Box No. ______

Meter Box No. ______

Meter H@ ______

C Factor ______

Pilot Tube Coefficient C_p ______

Schematic of Stack Cross Section

Ambient Temperature ______

Barometric Pressure ______

Assumed Moisture % ______

Probe Length, m(ft) ______

Nozzle Identification No. ______

Average Calibrated Nozzle Diameter, cm (in) ______

Probe Heating Setting ______

Leak Rate, m^3/min. (cfm) ______

Probe Liner Material ______

Static Pressure, mm Hg (in. Hg) ______

Filter No. ______

Traverse Point Number	Sampling Time (0) Min.	Vacuum mm Hg (in. Hg)	Stack Temperature (T_s) °C (°F)	Velocity Head (P_s) mm (in) H_2O	Pressure Differential Across Orifice Meter mm (H_2O) (in H_2O)	Gas Sample Volume m^3 (ft^3)	Gas Sample Temp. at Dry Gas Meter		Filter Holder Temperature °C(°F)	Temperature of Gas Leaving Last Impinger °C(°F)
							Inlet °C(°F)	Outlet °C(°F)		
Total							Avg.	Avg.		
Average										

340434ER

Figure 2. Field Data Sheet

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:

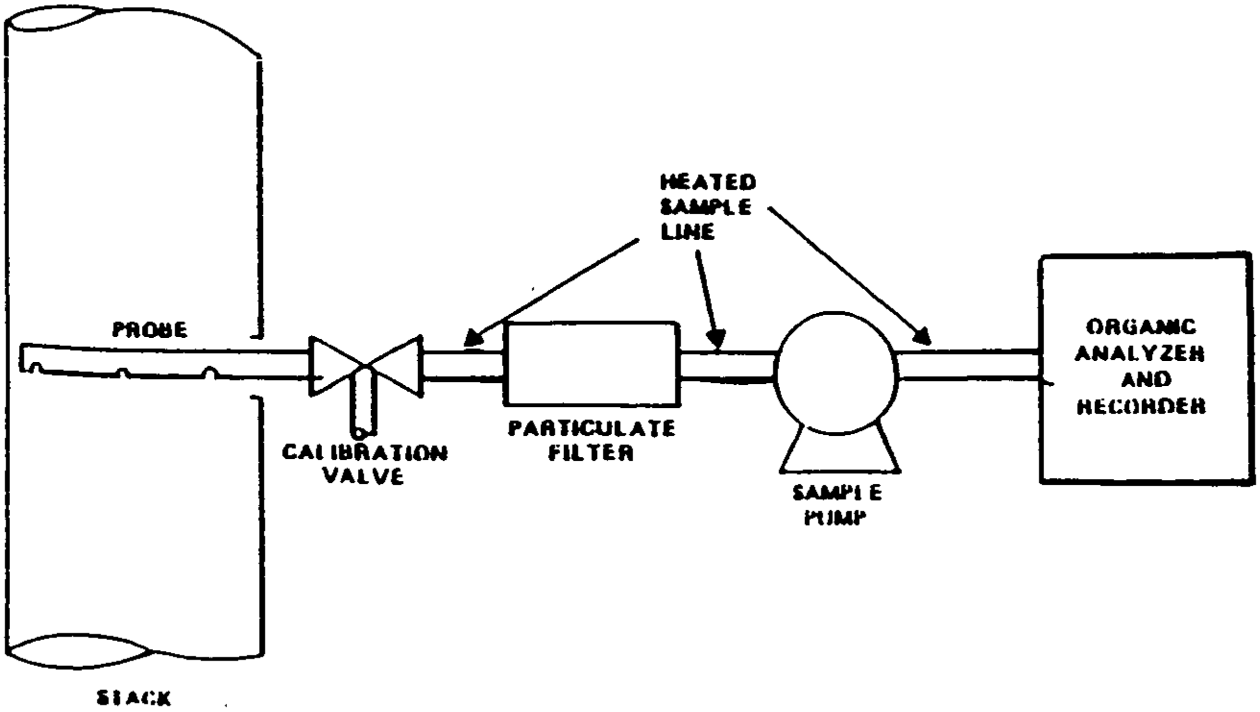


Figure 25A-1. Organic Concentration Measurement System.

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.

4.1 Fuel. A 40 percent H_2/60 percent He or 40 percent H_2/60 percent N_2 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

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

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

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

7. *Emission Measurement Test Procedure*

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

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

8. *Organic Concentration Calculations*

Determine the average organic concentration in terms of ppmv as propane or other calibration gas. The average shall be determined by the integration of the output recording over the period specified in the applicable regulation.

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

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

Where:

C_c = Organic concentration as carbon, ppmv.
C_{meas} = Organic concentration as measured, ppmv.
K = Carbon equivalent correction factor,
  K = 2 for ethane.
  K = 3 for propane.
  K = 4 for butane.
  K = Appropriate response factor for other organic calibration gases.

9. *Bibliography*

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

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

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

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.

7/90

CONFIDENTIAL

version 1.1

Interpoll Laboratories
Method II-3791

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 <u>expressly</u> to accomodate the conditions normally encountered in board press exhaust gas stacks and <u>may not be appropriate</u> 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 $t_{\text{[illegible]}} \leq 18\ ^{0}\text{C}$ then $\o \leq 10$ HRS

   $18 \leq t_{\text{[illegible]}} \leq 29\ ^{0}\text{C}$ then $\o \leq 5.5$ HRS

   $29 \leq t_{\text{[illegible]}} \leq 40\ ^{0}\text{C}$ then $\o \leq 3$ HRS

   where $\o$ = 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 ≥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: (ppb v/v) = 0.0978 X (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
Matrix:	Air	Range:	0.43 to 78 ppb 4.4 to 800 $\mu g/m^3$
Procedure:	Collection and derivatization on impregnated filter, HPLC	Precision:	0.078
Date Issued:	8/31/81		
Date Revised:		Classification:	E (Proposed)

$PPB = 0.0978(\mu g/m^3)$

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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 $\mu g/m^3$ for 180-L air samples and at ceiling concentrations ranging from 80 to 1000 $\mu g/m^3$ 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 µg/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 µg/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 µg/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 μm; surface area, 400 m^2/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 µL
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-µL 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-μL aliquots to filters (a solution at a concentration of 0.08 μg/μL would be appropriate for the application of 0.8 μg 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 μL 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.

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 μg 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 μg 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 μL 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 μL 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 μg 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-μL 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 μg/μL 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 μg/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 μg/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.

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FIELD TEST OF A GENERIC METHOD FOR SAMPLING AND ANALYSIS OF ISOCYANATES

Interim Report
(Work Assignment 55)

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DISCLAIMER

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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 μg
Significant?	No
Correction Factor	1.0[c]
Recovery[a]	
Amount Spiked (as TDI)	7828 μg
Average Percent Recovered	95

[a] Results 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.

[b] EPA Method 301 requires the precision to be <50% RSD for the method to be acceptable.

[c] EPA 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.

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1.0 INTRODUCTION

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)[a]
Methylene diphenyl diiocyanate (MDI)
Methyl isocyanate (MI)

[a] The 2,6 TDI isomer may also be present but is not listed in the CAAA.

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.

2.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results presented in Section 6.0 of this report, the following conclusions can be made concerning the validity of the method as tested under the conditions described in this report:

- The calculated values for precision (%RSD) for both the spiked and unspiked trains, 3.55 and 4.72 respectively, are both well within the acceptance criteria of less than 50% RSD found in Section 6.3 of the EPA Method 301. Therefore, the method as tested at the source category described meets the precision requirements;
- The method bias, at the concentration levels tested, was found to be significantly different from zero at the 95% level of confidence when the data from all eight runs (minimum of six runs required) were used in the calculations. A correction factor of 1.053 would be required if all eight runs are included in the bias calculation. Good technical reasons exist for excluding one of eight QUAD runs. If this run is eliminated, no bias correction is required. In either case the correction factor is well within the acceptance criteria of 0.7 to 1.3 found in Section 1.2 of the EPA Method 301. Therefore, the method as tested at the source category described meets the bias and correction factor requirements; and
- The method as tested is sufficiently robust to allow testing at sources similar to the source tested in this study where the stack gas moisture is less than 1% by volume, the stack temperature is less than 30 degrees C and the presence of other compounds that may interfere with the analysis are minimal.

Recommendations for future testing and validation of the method for the sampling and analysis of isocyanates include the following:

- Identify a source for testing that has more than one isocyanate present in the stack gas;
- Spike as many of the four CAAA target isocyanates as possible into the train before sampling in order to gain as much information as possible from the field test; and

- Design the condenser between the first and second impinger of the train to more efficiently reduce the loss of toluene from the first impinger and minimize compound breakthrough due entrained aerosols.

3.0 FIELD TEST

The objective of this program was to perform a field test to establish the bias and precision of a sampling and analytical method for isocyanate compounds listed in Title III of the Clean Air Act Amendments of 1990. The method evaluation in this test series resulted from extensive literature reviews, industry consultation and laboratory development. To achieve the test objective, an industrial source with known emissions of TDI was selected as a field test site. Factors in the site selection were easy access, ample space for the quadruple sampling trains and proximity to Radian's office and laboratory in Research Triangle Park, North Carolina.

3.1 Site Description

The field validation test was performed at a flexible foam production plant located in High Point, North Carolina. In the manufacturing process starting materials (TDI, water, a polyether resin, methylene chloride, an amine catalyst, and coloring additives) are blended and continuously fed onto a conveyer belt. The TDI reacts with water and releases CO_2, which causes foaming in the resin material. Dichloromethane (DCM) can be added as a supplemental "blowing" or foaming agent. The heat from the reaction of TDI and water causes the DCM to vaporize, resulting in increased foaming. The density of the foam is controlled by the amount of TDI, water and DCM added. The foaming action continues as the material proceeds down the conveyer belt. Finished product is then allowed to cure and degas for 24 to 48 hours.

3.2 Sampling Location

Figure 3-1 presents a schematic view of the sampling location. Three induced draft (ID) fans are used to exhaust TDI and DCM vapors from the production process through three separate uninsulated sheet metal ducts that extend through the roof. Two of the ducts are connected by a 30-foot horizontal duct, 34 inches in diameter, which then extends vertically to a height of 25 feet above the roof top. A 6 inch

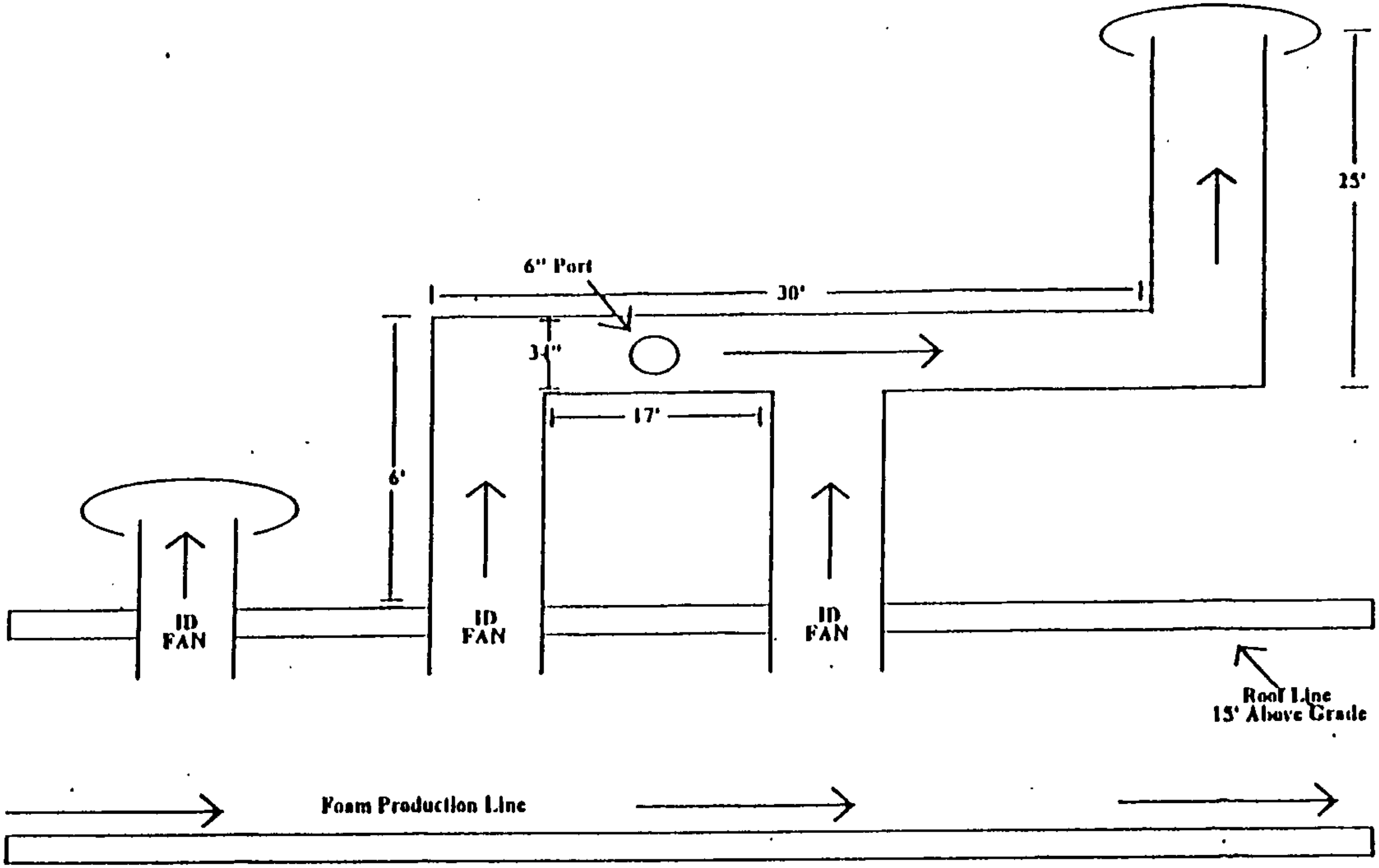


Figure 3-1. Sample Location

diameter sampling port is located in the horizontal duct midway between vertical ducts number 2 and 3, approximately 5 feet above the roof level. The roof level is approximately 15 feet above the ground.

A recovery trailer was located on the ground immediately in front of the sampling area, allowing easy communication between the sampling crew and recovery area. Two-way radio communication between the facility production personnel and the sampling crew allowed coordination between production startup and the start of each sampling run.

3.3 Test Schedule

The recovery trailer and test equipment were mobilized on Saturday, February 20, 1993. Equipment setup took place Saturday afternoon and Sunday, and testing began Monday morning.

The sampling schedule is shown in Table 3-1. Eight runs were completed, which included two extra runs above the required minimum of six.

3.4 Sample Collection

3.4.1 Quad Probe

Sampling was performed by withdrawing stack gas from a single port in the stack through a quad probe, then directing the sampled gas simultaneously to four independently operated sampling trains. The quad probe contains four similar heated sampling probes that were inserted into the stack as one unit, as shown in Figure 3-2. The front end of the quad probe was positioned in the center of the stack and remained

Table 3-1

Test Schedule

Run	Date	Start Time	Stop Time
1	2-22-93	1215	1300
2	2-22-93	1330	1410
3	2-23-93	0945	1085
4	2-23-93	1335	1415
5	2-24-93	1010	1110
6	2-24-93	1335	1420
7	2-25-93	1215	1255
8	2-25-93	1315	1355

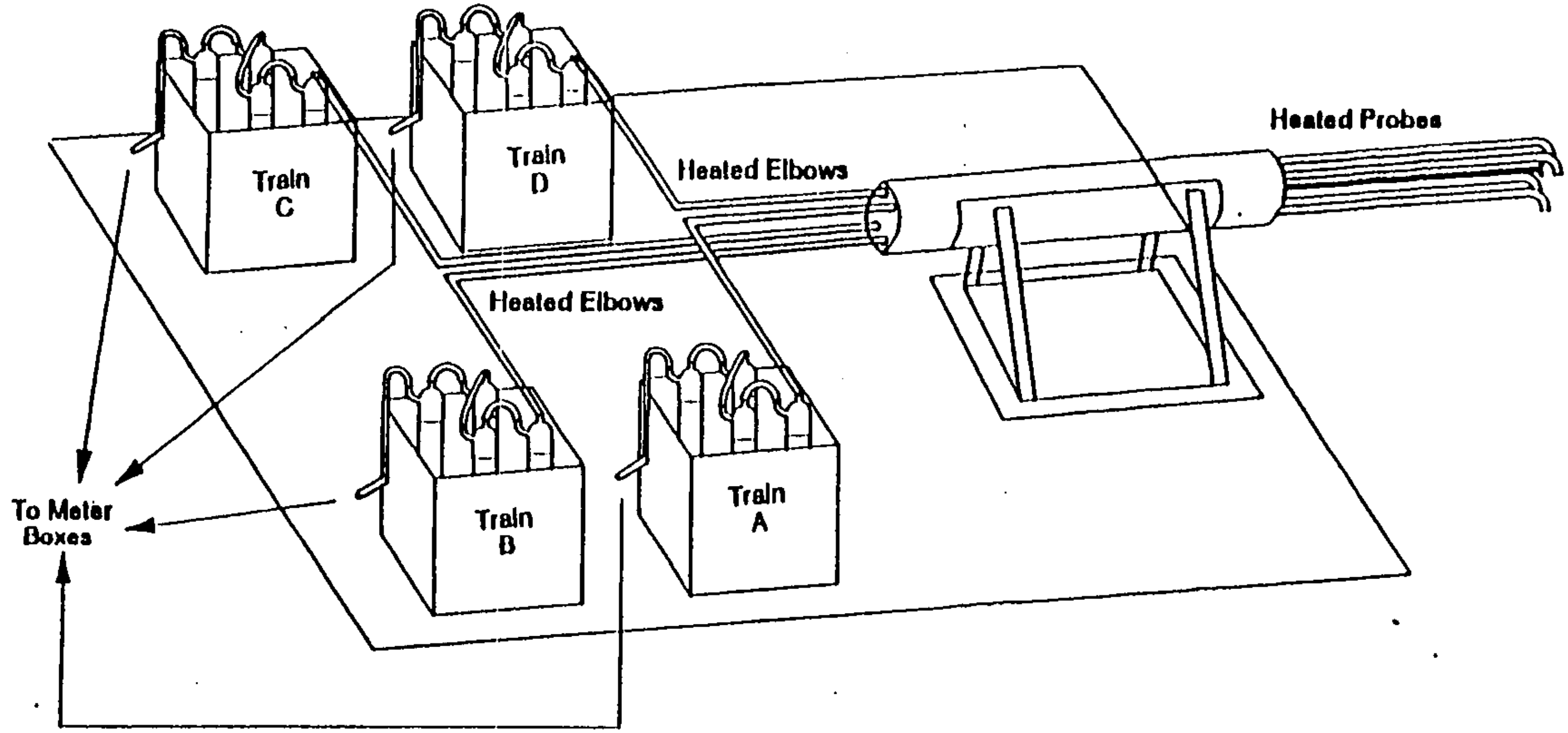


Figure 3-2. Schematic of Quad Train Setup

in that location during each test. The stack was not traversed nor were stack gas velocity measurements made, because determination of the true concentration and emission rate of the target compound in the stack gas was not required to meet the objectives of this program.

Method 301 of 40 CFR Part 63 describes field validation procedures and details the criteria for the quadruple sampling probe tip arrangement. This method requires the inside edge of sampling probe tips to be situated in a 6.0 cm x 6.0 cm square area. The area encompassed by the probe tip arrangement should occupy less than 5% of the stack cross-sectional area. The cross-sectional area of the probe tip arrangement used in this test was 5.8 square inches as measured from the probe/nozzle centerlines. This area is less than 1% of the stack cross-sectional area of 908 square inches, which satisfies the Method 301 criterion.

3.4.2 Quad-Train Assembly

Four independent sampling trains made up the quad-train assembly. Although four meter boxes were required, the velocity head (ΔP) was determined using only one set of pitot tubes. The sampling trains were identified as Train A, B, C, and D. Two of the four trains were spiked before each run. The spiking compound was added to the first impinger of these trains in the field for bias determination. The sampling train test matrix is given in Table 3-2.

3.5 Sampling Preparation

3.5.1 Glassware Preparation

All glassware used for sampling was thoroughly cleaned prior to use. This included the probe, impingers, all sample bottles and all utensils used during sample recovery. All glassware was washed with hot soapy water, rinsed with hot tap water, rinsed with distilled water and baked in a oven at 300 °C for four hours. The glassware

Table 3-2

Sampling Train Test Matrix

	Train Designation	
Run #	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 μg/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 ft^3 were used for the two lower orifice settings, and volumes of 10 ft^3 were used for the higher settings. The individual gas meter correction factors (γi) were calculated for each orifice setting and averaged. The method requires that each of the individual correction factors fall within ±2% of the average correction factor or the meter must be cleaned, adjusted, and recalibrated. In addition, Radian requires that the average correction factor be 1.00 ±1 percent. For the post-test calibration, the meter was calibrated three times at the average orifice setting and vacuum which were used during the actual test.

Dry gas meter calibrations were performed at Radian's laboratory using an American® wet test meter as an intermediate standard. The intermediate standard is calibrated every six months against the EPA spirometer at EPA's Emission Measurement Laboratory in Research Triangle Park (RTP), North Carolina.

3.5.5 Sampling Operations

Vent gas samples were collected isokinetically from a single sampling point located in the center of the duct. Preliminary information about the stack gas velocity useful in selecting nozzle size and calculating the K-factor was obtained during the pre-site survey. Prior to testing, a leak check of pitot lines was performed according to EPA Method 2. Oxygen (O_2) and carbon dioxide (CO_2) concentrations were ambient levels as determined by EPA Method 3. The stack gas moisture data was measured by the host facility as the relative humidity.

Preparation of Sampling Train

The four sampling trains for each QUAD run were charged and assembled in the recovery trailer. The impinger buckets were marked as Train A, B, C, or D. Tared impingers were used. Approximately 300 mL of the absorbing reagent was transferred to the first impinger and 200 mL to the second impinger. The first impinger of each train was of a Greenburg-Smith design and all remaining impingers were of the modified Greenburg-Smith design. The third impinger was empty, 200 to 300 g of silica gel was placed in the fourth impinger and 400 g of charcoal was placed in the fifth impinger. A water jacketed condenser was placed between the outlet of the first impinger and the inlet to the second impinger to promote cooling and minimize evaporative loses 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° ± 12°C (248° ± 25°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

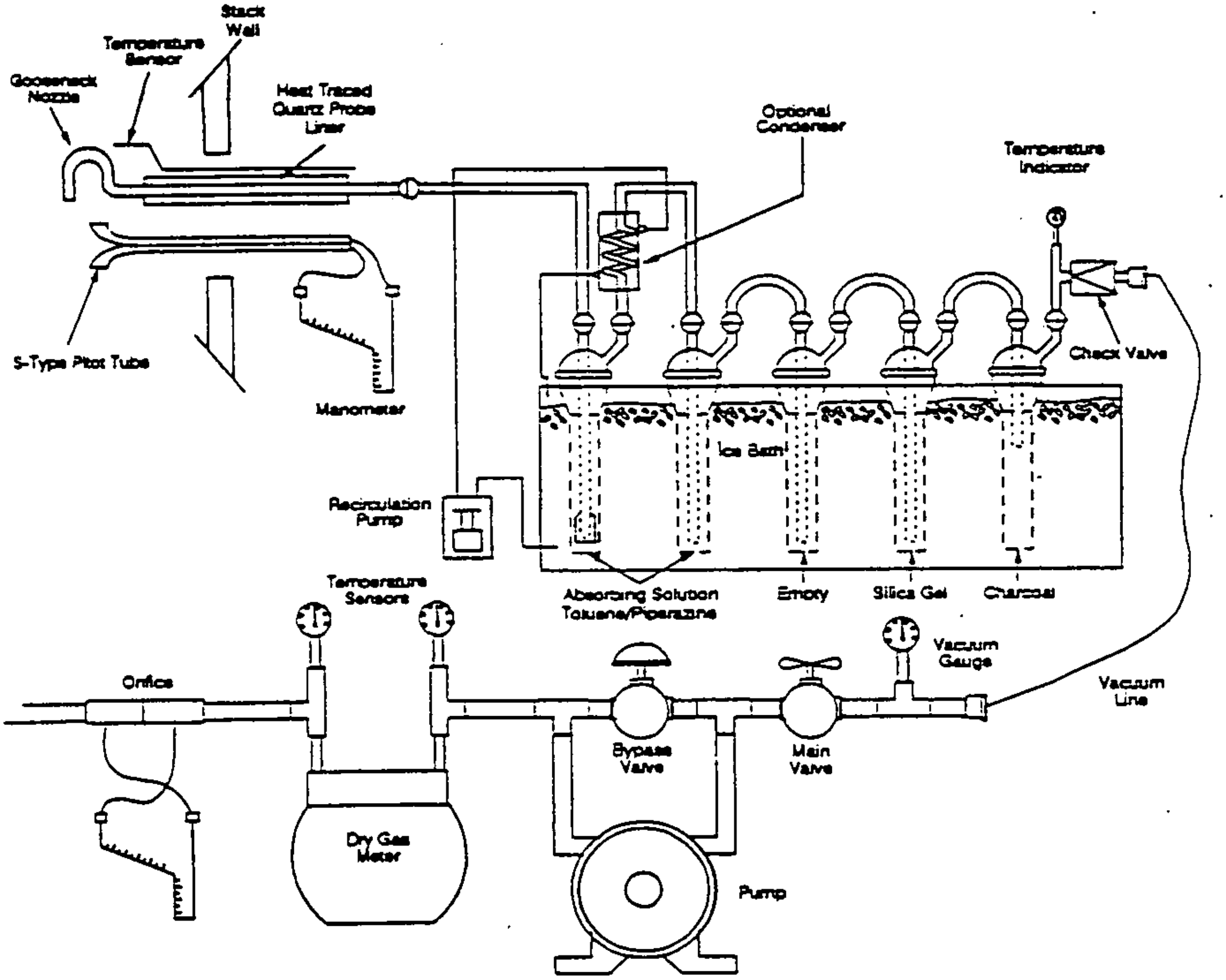


Figure 3-3. Sampling Train for Isocyanate

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± 12°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 μg/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.

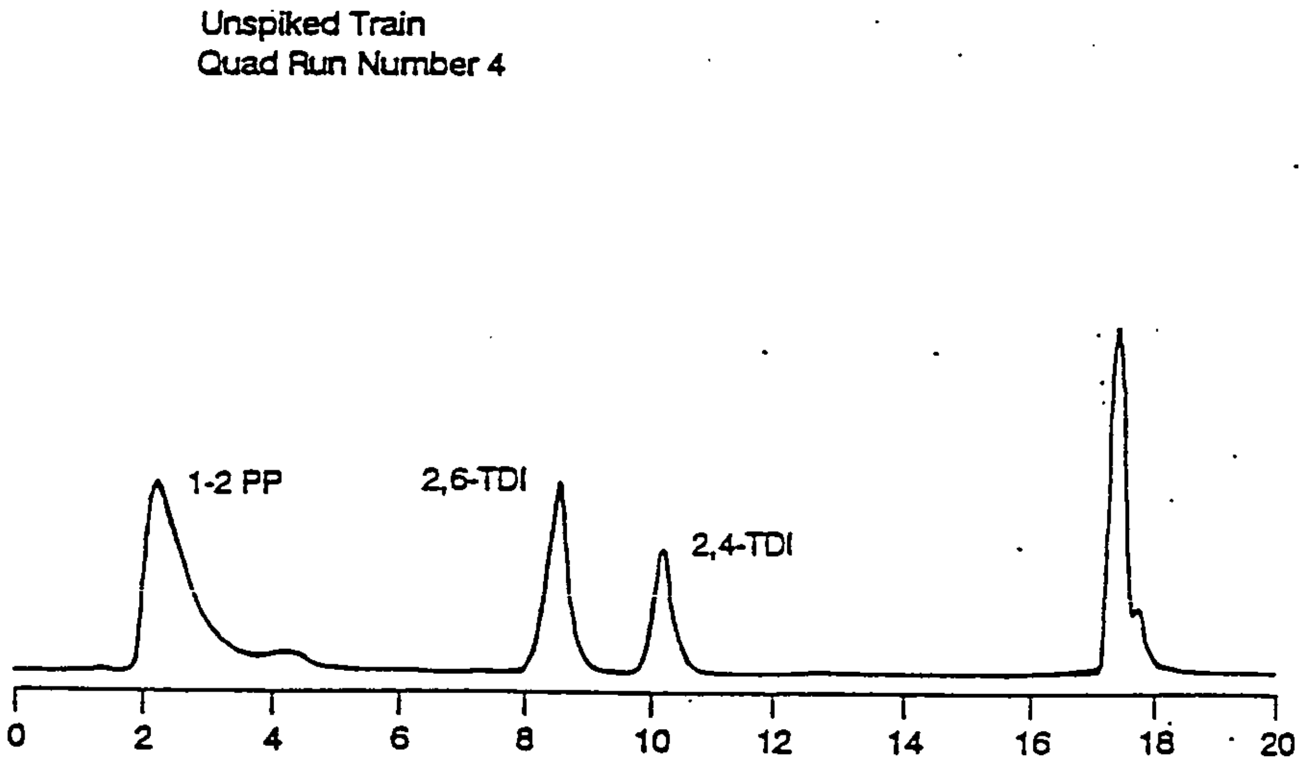


Figure 4-1. Chromatogram of Unspiked Train

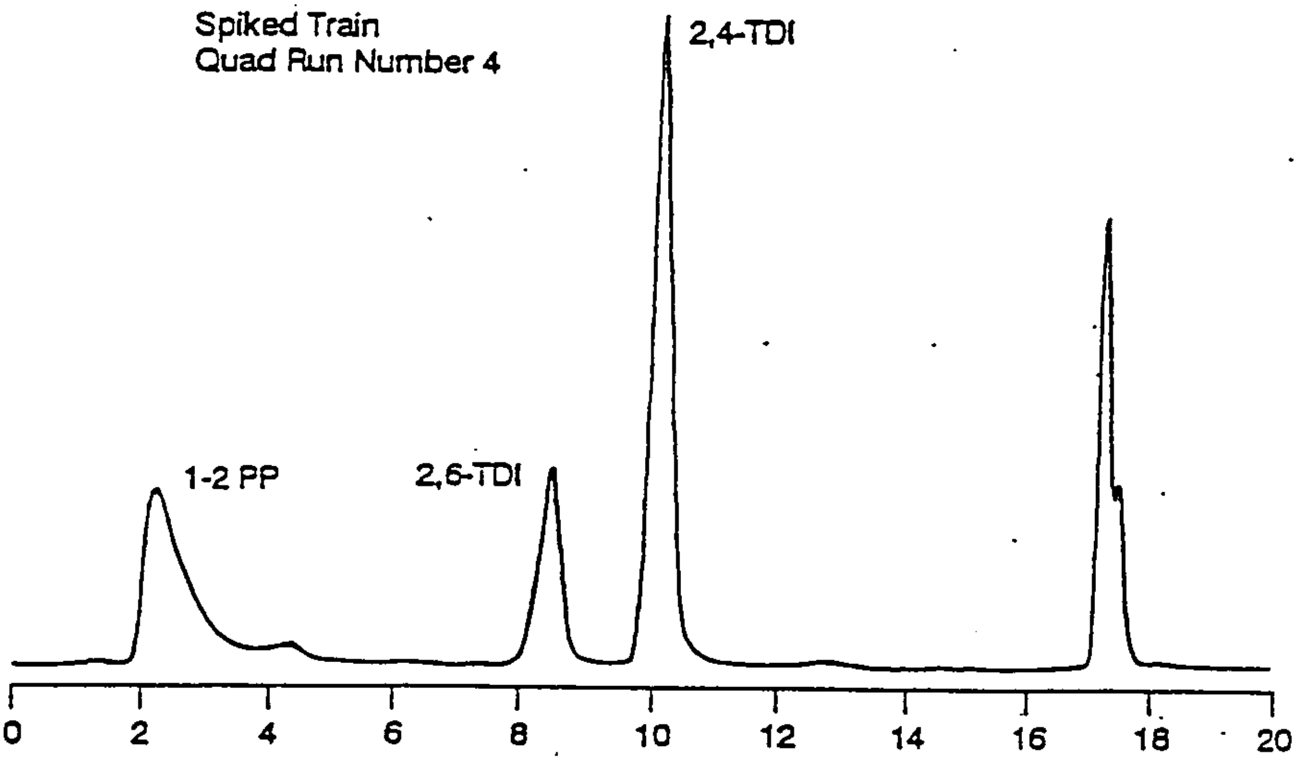


Figure 4-2. Chromatogram of Spiked Train

The concentration of isocyanate (as the derivative) in the concentrated samples was then calculated as follows:

$$\text{Concentration} = \frac{(\text{Sample Response} - \text{Intercept})}{\text{Slope}} \qquad 4\text{-}1$$

The total amount (μg) collected in a sample was then calculated by multiplying the concentration (μg/mL) times the final volume (10 mL) of ACN used to redissolve the concentrated sample.

$$\text{Amount TDI derivative} = \text{Concentration } (\mu\text{g/mL}) \times \text{Final Volume } (10\text{ mL}) \qquad 4\text{-}2$$

The equivalent amount of TDI required to generate this much derivative was calculated by multiplying the ratio of the molecular weights of TDI (174) and the TDI derivative (501) times the amount of TDI derivative (determined by using equation 4-2).

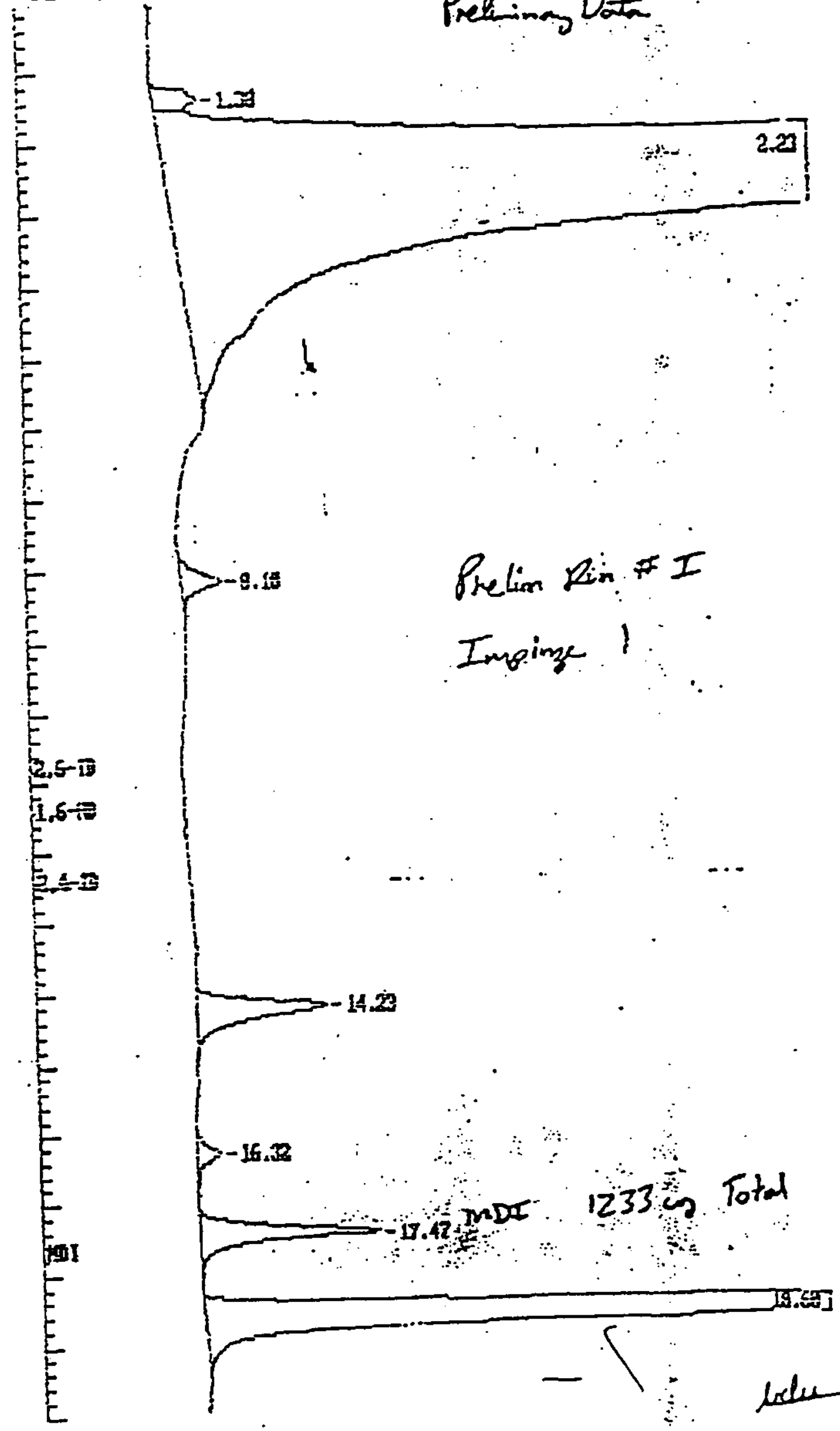
The total amount of 2,4-TDI (underivatized) collected in the unspiked and spiked trains is given in Table 4-1 and Table 4-2 respectively.

4.4.2 Normalization of the Amount of Isocyanate Collected

In order to simplify the comparison of the analytical results of the four trains in each QUAD run for subsequent calculations of bias and precision, the test plan called for the collected of 30 ft^3 of sample in each train. Due to operational variabilities inherent to each train, accurate but slightly differing sample volumes resulted as shown in Table 3-3. Therefore, it was necessary to normalize the data presented in Tables 4-1 and 4-2 to a common sample volume. The sample volume to which all data were normalized was selected to be 35.31 ft^3 which is equivalent to 1m^3. The following stepwise calculations were used to normalize the data. The data from QUAD run number 1 are used as an example.

Data File = E:\S3253F6.PTS Printed on 09-10-1993 at 12:29:41 Offset: 0 cts
Start time: 0.00 min. Stop time: 20.00 min.
Full Range: 50 K-Counts

Preliminary Data



Prelim Run # I

Impinger 1

MDI 1233 ug Total

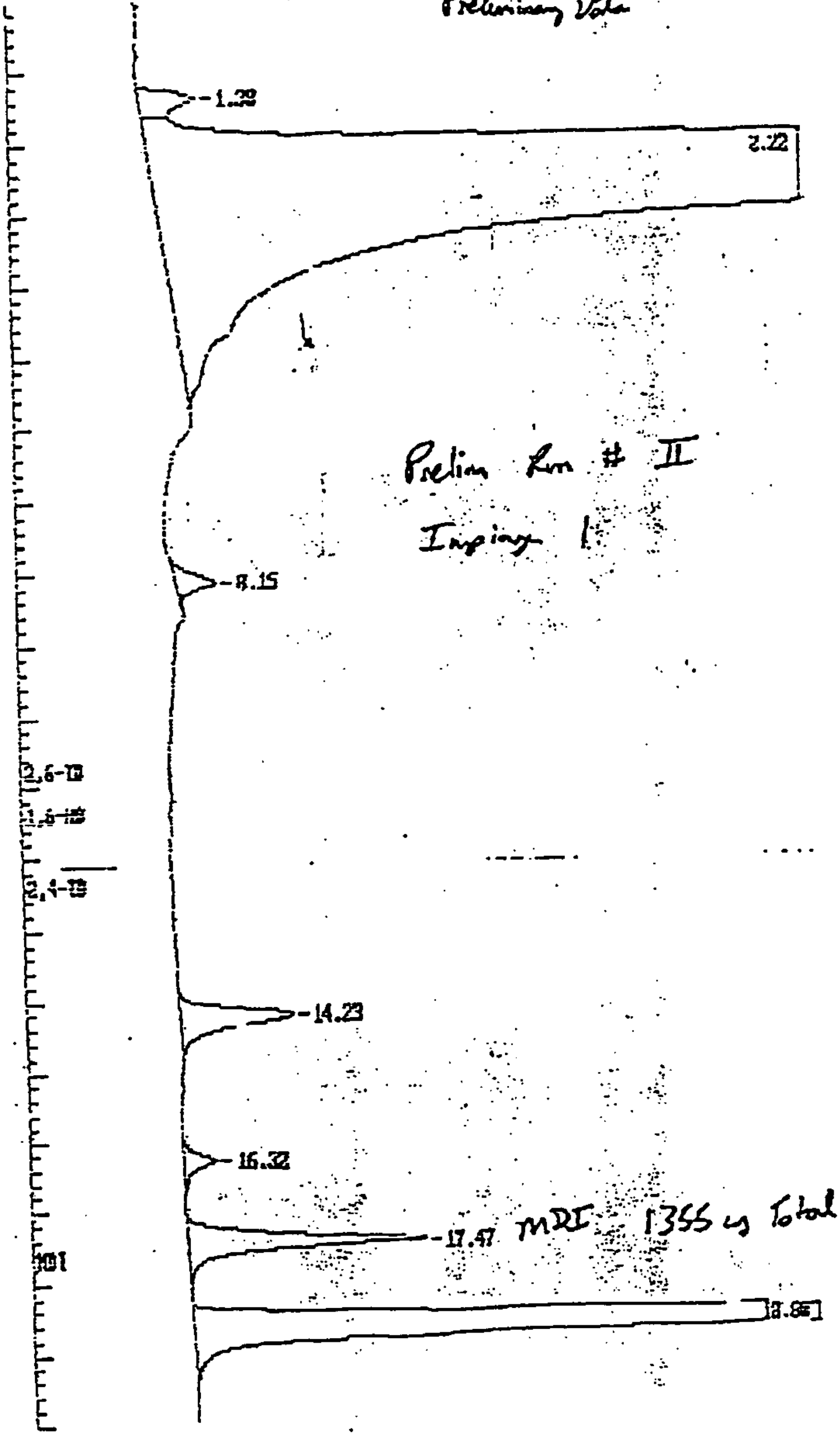
Ratio 13 check 10

[illegible] in [illegible]

SENT BY:

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



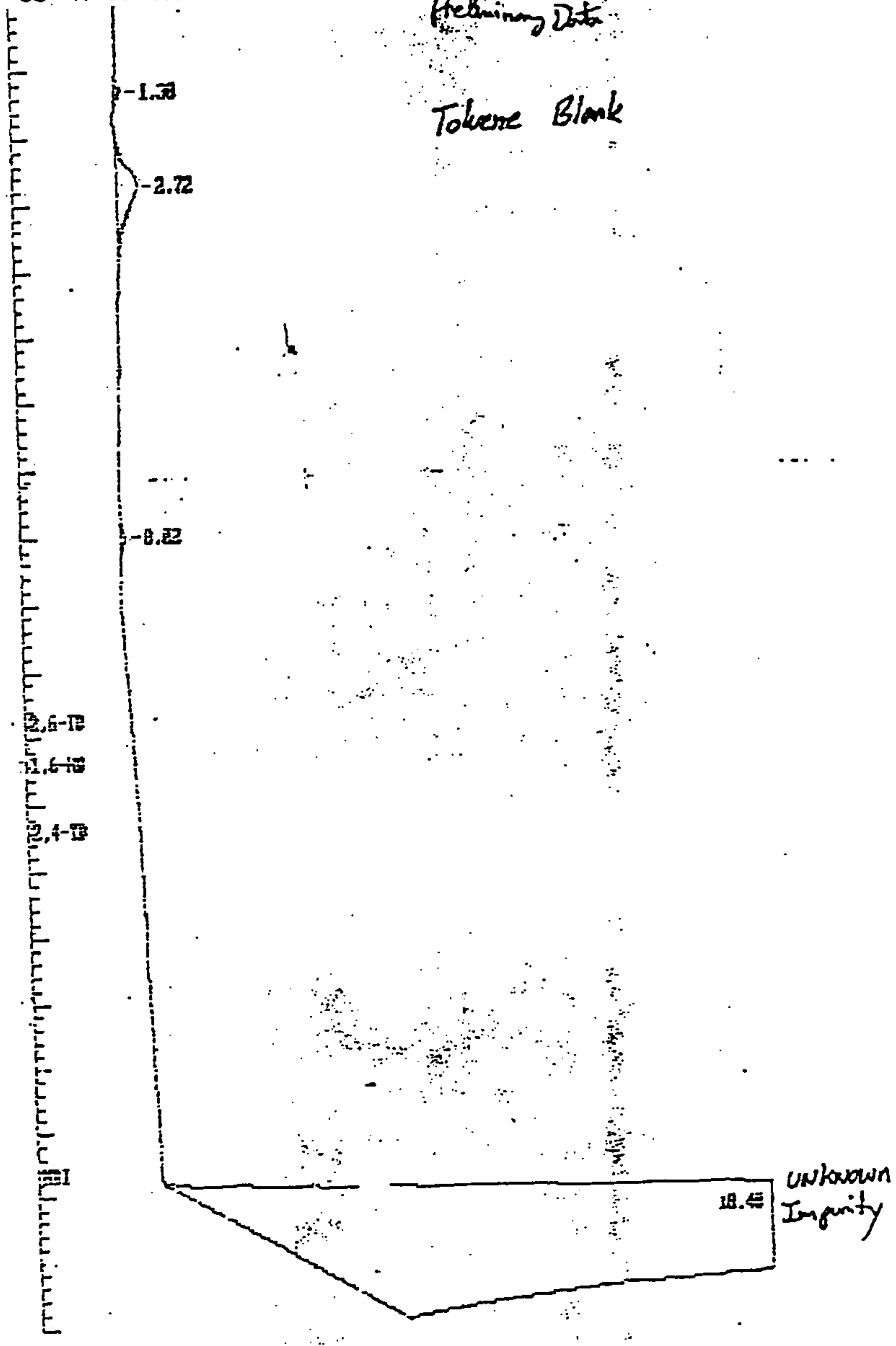
Prelim Run # II
Impinger 1

MRI 1355 ug Total

Data File = E:\S3256F7.PTS Printed on 09-13-1993 at 14:43:58
Start time: 0.00 min. Stop time: 20.00 min. Offset: 0 cts
Full Range: 50 K-Counts

Preliminary Data

Toluene Blank



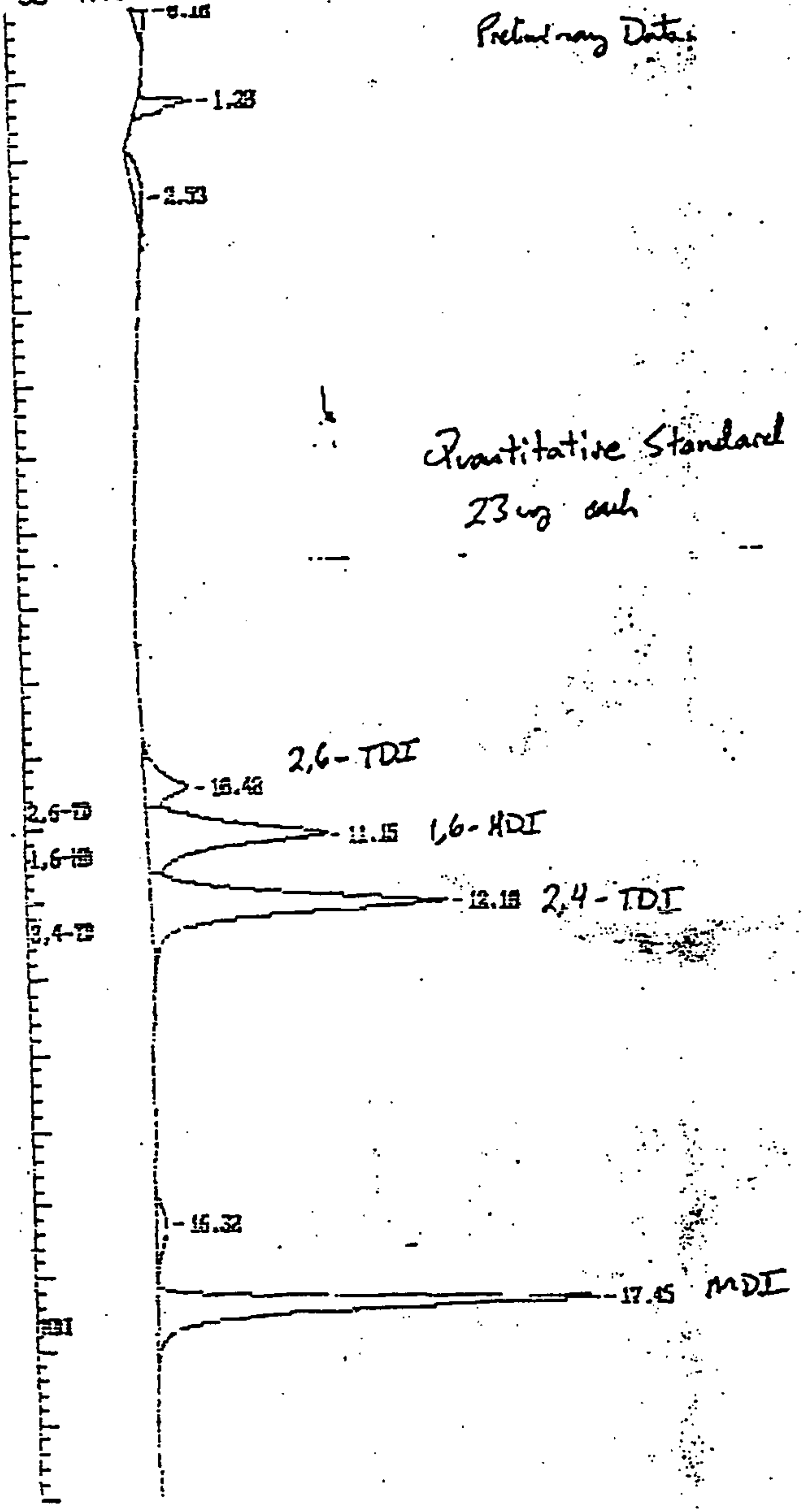
Unknown Impurity

SENT BY:

Data File: c:\[illegible]

Start time: 0.00 min. Stop time: 20.00 min. Offset: 0 cts

Full Range: 50 K-Counts



Preliminary Data

Quantitative Standard
23ug 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	--	--	--

[1] The unspiked trains alternated from run to run, C and D then A and B.
[2] All 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	--	--	--

[1] The unspiked trains alternated from run to run, C and D then A and B.
[2] All 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

[1] The spiked trains alternated from run to run, A and B then C and D.

[2] All values are in micrograms of underivatized TDI.

Table 4-2 (Continued)

Train[1]	QUAD Run No.											
	5			6			7			8		
	Imp 1	Imp 2	Total	Imp 1	Imp 2	Total	Imp 1	Imp 2	Total	Imp 1	Imp 2	Total
A	12014	45	12059	--	--	--	10094	46	10140	--	--	--
B	12588	37	12625	--	--	--	9003	40	9043	--	--	--
C	--	--	--	15201	88	15289	--	--	--	10561	45	10606
D	--	--	--	15173	96	15269	--	--	--	10315	44	10359

[1] The spiked trains alternated from run to run, A and B then C and D.

[2] All 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;

$$\text{Train C} \quad \frac{33.42\ ft^3}{33.02\ ft^3}\ X\ 4409\ \mu g = 4462\ \mu g \qquad \text{4-3A}$$

$$\text{Train D} \quad \frac{33.42\ ft^3}{33.04\ ft^3}\ X\ 4416\ \mu g = 4467\ \mu g \qquad \text{4-3B}$$

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;

$$\frac{4462\ \mu g + 4467 \mu g}{2} = 4465\ \mu g \qquad \text{4-4}$$

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;

$$11943\ \mu g - 4465\ \mu g = 7478\ \mu g \qquad \text{4-5}$$

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;

$$\frac{35.31\ ft^3}{33.42\ ft^3}\ X\ 4465\ \mu g = 4718\ \mu g \qquad \text{4-6}$$

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;

$$\frac{35.31\ ft^3}{33.42\ ft^3}\ X\ 63.9\ \mu g = 67.5\ \mu g \qquad 4\text{-}7$$

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 ft^3;

$$7478\ \mu g + 4718\ \mu g + 67.5 \mu g = 12264\ \mu g \qquad 4\text{-}8$$

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 $1m^3$ 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	--

[1] The unspiked trains alternated from run to run, C and D then A and B.

[2] All values are in micrograms of underivatized TDI, normalized to a sample volume of 35.31 ft^3 ($1m^3$).

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

[1] The spiked trains alternated from run to run, A and B then C and D.

[2] All values are in micrograms of underivatized TDI, normalized to a sample volume of 35.31 ft^3 ($1m^3$).

- Analysis of field spiked QC samples; and
- Analysis of check standards every 3 samples.

5.0 RESULTS AND DISCUSSION

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	–	–

[1] Values are presented as μg of underivatized TDI

5.2 Breakthrough and Recovery

This section presents details of the breakthrough and recovery results for the field samples, as well as recovery information for the spiked compound (2,4-TDI).

5.2.1 Breakthrough

Tables 4-1 and 4-2 provide a summary of the combined total mass of 2,4-TDI collected in the probe/first impinger and second/third impinger samples for the unspiked and spiked trains, respectively. These totals are used as a basis for calculating breakthrough of the TDI from the first impinger to the second impinger. The mass of compound found in the probe/first impinger fraction and in the second impinger fraction were each divided by the total mass of TDI for that train and then multiplied by 100 to yield the percent of the total TDI found in the separate train sections. The results are presented in Table 5-2 and 5-3 for the spiked and unspiked trains respectively.

The average breakthrough for the spiked trains was 1.5% and for the unspiked trains 1.1%. More than 98% of the TDI was collected in the first impinger under the sampling conditions used in this study.

The amount of the toluene contained in the first impingers of each of the trains was reduced by approximately 25% (by weight) during the sampling run due to evaporation. The second impingers showed, on the average, a net gain of approximately 5%. The remainder was collected in the silica gel and the charcoal, both of which showed net weight gains. The total weight gained in the train components following the first impinger more than compensate for loses 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							

[1] Spiked Trains alternate from run to run, A and B, then C and D.
[2] Values 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							

[1] Unspiked Trains alternate from run to run, C and D, then A and B.
[2] Values 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							

[1] Spiked Trains alternated from run to run, A and B, then C and D.

[2] Values 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 (±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	±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	±15%	±10%
HPLC Calibration Check	±10% of Curve	±9%
HPLC System Blank	<0.1% Analyte level	<0.1%
HPLC Replicate Analyses	±10% of 1st injection	±2%
HPLC Method Spikes	±20% of theoretical	±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

[a] The 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

[1] Average of four, ranging from 0.1 to 1.2 µg
[2] Average of four, ranging from 0.1 to 0.8 µg
[3] Average of three, ranging from 0.3 to 20.7 µg
[4] NA, 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%	1-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				1-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%	1-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	33.89	1.04204	29.0				1-B-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			1-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				1-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			1-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				1-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	103848	0.49			100	49.4								
ARL-16	102349	0.49			100	48.7								
ISO-SCF-32293-4	1246426	5.82	5.40641	8%	1	5.8								
ISO-SCF-32293-4	1237852	5.78	5.40641	7%	1	5.8								
ISO-SCF-32293-4	1239959	5.79	5.40641	7%	1	5.8								

Sample Name	AREA	AMOUNT ug/mL	QC Con ug/mL	QC Bias %	Dilution Factor	Amount Sample ug	Avg Amt Sample ug	Volume Sampled Cu Ft	Sampling Factor	Adjusted Avg ug	Total Train ug	Amount Spiked ug	Spike Recovery %	Train ID
ARL-17	1229990	5.75			2000	11492.4	11487.9	34.24	1.03139	11587.8	11624.8	7827.81	106.14%	3-A-1
ARL-17	1214060	5.67			2000	11343.9								
ARL-17	1244450	5.81			2000	11627.3								
ARL-18	75825	0.36			100	36.4	35.9	34.24	1.03139	37.0				3-A-2
ARL-18	74917	0.36			100	36.0								
ARL-18	73672	0.35			100	35.4								
ARL-19	1282836	5.99			2000	11985.3	12024.4	35.15	1.00468	12039.7	12077.7	7827.81	111.93%	3-B-1
ARL-19	1289518	6.02			2000	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	1.03441	12187.3	12233.3	7827.81	89.41%	5-A-1
ARL-33	1323802	6.18			2000	12367.4								
ARL-33	1224229	5.72			2000	11438.7								
ARL-34	103486	0.49			100	49.3	44.5	34.14	1.03441	46.1				5-B-1
ARL-34	103816	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	84360	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	4791.9	4809.8	34.46	1.02480	4929.1	4946.9			5-C-1
ARL-37	520667	2.44			2000	4876.5								
ARL-37	507945	2.38			2000	4757.9								
ARL-38	36452	0.18			100	18.0	17.4	34.46	1.02480	17.8				5-C-2
ARL-38	36462	0.18			100	18.0								
ARL-38	32321	0.16			100	16.1								
ARL-39	532851	2.50			2000	4990.2	5054.0	32.59	1.08360	5476.5	5521.9			5-D-1
ARL-39	544154	2.55			2000	5095.6								
ARL-39	542068	2.54			2000	5076.1								
ARL-40	90692	0.43			100	43.3	41.9	32.59	1.08360	45.4				5-D-2
ARL-40	82975	0.40			100	39.7								
ARL-40	89246	0.43			100	42.6								
ISO-SCF-32293-4	1187611	5.55	5.40641	3%	1	5.5								
ISO-SCF-32293-4	1199464	5.60	5.40641	4%	1	5.6								
ISO-SCF-32293-4	1183133	5.53	5.40641	2%	1	5.5								

Sample Name	AREA	AMOUNT ug/mL	QC Con ug/mL	QC Bias %	Dilution Factor	Amount Sample ug	Avg Amt Sample ug	Volume Sampled Cu Ft	Sampling Factor	Adjusted Avg ug	Total Train ug	Amount Spiked ug	Spike Recovery %	Train ID
ARL-41	861252	4.03			2000	8053.2	7887.9	35.10	1.00612	7936.1	8041.6			6-A-1
ARL-41	860232	4.02			2000	8043.7								
ARL-41	809094	3.78			2000	7566.7								
ARL-42	227095	1.07			100	106.9	104.8	35.10	1.00612	105.4				6-A-2
ARL-42	228142	1.07			100	107.4								
ARL-42	212430	1.00			100	100.1								
ARL-43	815730	3.81			2000	7628.6	7488.0	35.17	1.00411	7518.8	7607.6			6-B-1
ARL-43	825689	3.86			2000	7721.5								
ARL-43	760533	3.56			2000	7113.8								
ARL-44	193894	0.91			100	91.4	88.5	35.17	1.00411	88.8				6-B-2
ARL-44	197908	0.93			100	93.3								
ARL-44	170746	0.81			100	80.6								
ISO-SCF-32293-4	1189088	5.56	5.40641	3%	1	5.6								
ISO-SCF-32293-4	1190921	5.56	5.40641	3%	1	5.6								
ARL-45	1656820	7.74			2000	15473.5	15201.1	34.49	1.02391	15381.5	15471.2	7827.81	97.69%	6-C-1
ARL-45	1652121	7.71			2000	15429.7								
ARL-45	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	1589678	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	1183664	5.53	5.40641	2%	1	5.5								

Sample Name	AREA	AMOUNT ug/mL	QC Con ug/mL	QC Bias %	Dilution Factor	Amount Sample ug	Avg Amt Sample ug	Volume Sampled Cu Ft	Sampling Factor	Adjusted Avg ug	Total Train ug	Amount Spiked ug	Spike Recovery %	Train ID
ARL-49	1081312	5.05			2000	10105.7	10094.4	31.11	1.13515	10398.3	10450.0	7827.81	100.45%	7-A-1
ARL-49	1074952	5.02			2000	10046.4								
ARL-49	1084020	5.07			2000	10131.0								
ARL-50	98427	0.47			100	46.9	45.6	31.11	1.13515	51.8				7-A-2
ARL-50	96270	0.46			100	45.9								
ARL-50	92145	0.44			100	44.0								
ARL-51	963252	4.50			2000	9004.6	9002.6	31.94	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	8931.4								
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	23.3	30.14	1.17169	27.3				7-C-2
ARL-54	49749	0.24			100	24.2								
ARL-54	44499	0.22			100	21.8								
ARL-55	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	228660	1.08			2000	2153.0								
ARL-56	75486	0.36			100	36.2	35.8	29.91	1.18070	42.3				7-D-2
ARL-56	75034	0.36			100	36.0								
ARL-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 Ft	Sampling Factor	Adjusted Avg ug	Total Train ug	Amount Spiked ug	Spike Recovery %	Train ID
ARL-57	374801	1.76			2000	3516.0	(3520.7	30.89	1.14324	4025.0	4086.0			8-A-1
ARL-57	377410	1.77			2000	3540.4								
ARL-57	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	113066	0.54			100	53.7								
ARL-59	406883	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	3831.8								
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	1108072	5.17			2000	10336.7								
ARL-64	92259	0.44			100	44.0	44.0	31.95	1.10531	48.6				8-D-2
ARL-64	92558	0.44			100	44.2								
ARL-64	91687	0.44			100	43.8								
ISO-SCF-32293-4	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	1255771	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	1232005	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	S3098F1	1158548	5.41	5.41	0%	1	5.4				
ARL-89	S3098F2	0	0.01			10	0.1	0.1			T-RB1
ARL-89	S3098F3	0	0.01			10	0.1				
ARL-89	S3098F4	0	0.01			10	0.1				
ARL-90	S3098F5	0	0.01			10	0.1	0.3			T-RB2
ARL-90	S3098F6	5758.5	0.04			10	0.4				
ARL-90	S3098F7	5867.5	0.04			10	0.4				
ARL-91	S3098F8	0	0.01			10	0.1	0.2			T-RB3
ARL-91	S3098F9	3273	0.03			10	0.3				
ARL-91	S3098F10	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	22909.08	0.12			10	1.2				
ARL-92	S3098F13	22154	0.11			10	1.1				
ISO-SCF-32293-4	S3098F14	1202488	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	6352.5	0.04			10	0.4	0.4			A-RB3
ARL-96	S3098F24	6438	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	1164824	5.44	5.41	1%	1	5.4	5.4			QC
ISO-SCF-32293-4	S3098F30	1159319	5.42	5.41	0%	1	5.4				
ISO-SCF-32293-4	S3098F31	1149310	5.37	5.41	-1%	1	5.4				
ARL-99	S3098F32	0	0.01			10	0.1	0.1			ABS-RB
ARL-99	S3098F33	0	0.01			10	0.1				
ARL-99	S3098F34	0	0.01			10	0.1				
ARL-100	S3098F35	0	0.01			10	0.1	0.1			ABS-RB
ARL-100	S3098F36	0	0.01			10	0.1				
ARL-100	S3098F37	0	0.01			10	0.1				
ARL-101	S3098F38	15010.13	0.08			10	0.8	0.9			ABS-RB
ARL-101	S3098F39	15823	0.08			10	0.8				
ARL-101	S3098F40	23127	0.12			10	1.2				
ARL-102	S3098F41	0	0.01			10	0.1	0.1			ABS-RB
ARL-102	S3098F42	0	0.01			10	0.1				
ARL-102	S3098F43	0	0.01			10	0.1				

Sample Name	FILE	AREA	AMOUNT ug/mL	QC Con ug/mL	QC Bias %	Dilution Factor	Amount Sample	Avg Amt Sample	Amount Spiked	Spike Recovery	Train ID
ISO-SCF-32293-4	S3098F44	1187727	5.55	5.41	3%	1	5.5	5.6			QC
ISO-SCF-32293-4	S3098F45	1199251	5.60	5.41	4%	1	5.6				
ISO-SCF-32293-4	S3098F46	1206006	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	204000	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	1164164	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.	1		2		3		4		5		6		7		8			
Train ID	A	B '	C	D	A	B	C	D	A	B	C	D	A	B	C	D	Average	RSD
% Recovery	95.69%	86.19%	89.16%	95.22%	106.14%	111.93%	96.56%	97.97%	89.41%	95.59%	97.69%	99.46%	100.45%	85.63%	88.46%	83.01%	95%	8%
Total ug	12283	11520	13258	13733	11625	12078	9694	9805	12233	12717	15471	15610	10450	9290	11197	10770	11982	16%

Amount Collected in Unspiked Quad Trains

Quad No.	1		2		3		4		5		6		7		8			
Train ID	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	Average	RSD
Total ug	4735	4811	6287	6270	3468	3166	2132	2139	4947	5522	8042	7608	2558	2618	4088	4579	4560	41%

Percent Carry over from 1st Impinger in Spiked Quad Trains

Quad No.	1		2		3		4		5		6		7		8			
Train ID	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	Average	RSD
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.	1		2		3		4		5		6		7		8			
Train ID	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	Average	RSD
1st Impinger	99.59%	98.11%	98.81%	99.24%	99.04%	98.94%	99.14%	98.76%	99.64%	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%	1.29%	1.09%	37.05%

AREAL WA 55 -- Method 301 Results

Using Modified Data

Run	Train				Amount	Precision of UNSpiked Samples			
#	A	B	C	D	Spiked	Diff	STDu	STDm	RSD
1	12263.0	11520.0	4735.0	4811.0	7827.81	-76.00	216.596	30.942	4.721
2	6287.0	6270.0	13258.0	13733.0	7827.81	17.00			
3	11625.0	12078.0	3466.0	3166.0	7827.81	300.00			
4	2132.0	2139.0	9694.0	9805.0	7827.81	-7.00			
5	12233.0	12717.0	4947.0	5522.0	7827.81	-575.00			
6	8084.0	7608.0	15471.0	15610.0	7827.81	476.00			
7	10450.0	9290.0	2557.0	2616.0	7827.81	-59.00			

AREAL WA 55 -- Method 301 Results

Using Modified Data

Run	Train				Amount	Precision of Spiked Samples				Bias				CF
#	A	B	C	D	Spiked	Diff	SDs	SDm	RSD	Run	Compound	SD	t Test	
1	12263.0	11520.0	4735.0	4811.0	7827.81	743.00	430.48	162.71	3.55	-709.31	-295.41	481.90	-1.622	N/A
2	6287.0	6270.0	13258.0	13733.0	7827.81	-475.00				-610.81			^	
3	11625.0	12078.0	3466.0	3166.0	7827.81	-453.00				707.69			|	
4	2132.0	2139.0	9694.0	9805.0	7827.81	-111.00				-213.81			critical Value	
5	12233.0	12717.0	4947.0	5522.0	7827.81	-484.00				-587.31			is 2.160	
6	8084.0	7608.0	15471.0	15610.0	7827.81	-139.00				-133.31				
7	10450.0	9290.0	2557.0	2616.0	7827.81	1160.00				-544.31				

REAL WA 55 -- Method 301 Results

Using Modified Data

un	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	CF
1	12263.0	11520.0	4735.0	4811.0	7827.81	743.00	407.50	144.07	3.40	-709.31	-394.53	471.48	-2.367	1.053
2	6287.0	6270.0	13258.0	13733.0	7827.81	-475.00				-610.81			^	
3	11625.0	12078.0	3466.0	3166.0	7827.81	-453.00				707.69			|	
4	2132.0	2139.0	9694.0	9805.0	7827.81	-111.00				-213.81			critical Value	
5	12233.0	12717.0	4947.0	5522.0	7827.81	-484.00				-587.31			is 2.131	
6	8084.0	7608.0	15471.0	15610.0	7827.81	-139.00				-133.31				
7	10450.0	9290.0	2557.0	2616.0	7827.81	1160.00				-544.31				
8	4086.0	4579.0	11197.0	10947.0	7827.81	250.00				-1088.31				

APPENDIX M

CALCULATION EQUATIONS

METHOD 2
CALCULATION EQUATIONS

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

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

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

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

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

$$B_{ws}^* = RH(vp_{sdb})/P_s$$

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

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

SYMBOLS

A = Cross Sectional area of stack, SQ. FT.

A_n = Cross sectional area of nozzle, SQ. FT.

B_{ws} = Water vapor in gas stream, proportion by volume

C_p = Pitot tube coefficient, dimensionless

C_a = Concentration of particulate matter in stack gas, wet basis, GR/ACF

C_s = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, GR/DSCF

EA = Excess air, percent by volume

γ = Dry test meter correction factor, dimensionless

G_d = Specific gravity (relative to air), dimensionless

I = Isokinetic variation, percent by volume

M_d = Molecular weight of stack gas, dry basis, g/g - mole.

$\dot{m}_g$ = Mass flow of wet flue gas, LB/HR

$\dot{m}_p$ = Particulate mass flow, LB/HR

M_s = Molecular weight of stack gas, wet basis, g/g mole.

M_p = Total amount of particulate matter collected, g

P_{bar} = Atmospheric pressure, IN. HG. (uncompensated)

P_g = Stack static gas pressure, IN. WC.

P_s = Absolute pressure of stack gas, IN. HG.

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

A_a = Actual volumetric stack gas flow rate, ACFM

$Q_{s,d}$ = Dry volumetric stack gas flow rate corrected to standard conditions, DSCFM

RH = Relative humidity, %

T_{db} = Dry bulb temperature of stack gas, °F

T_{wb} = Wet bulb temperature of stack gas, °F

$T_{m(avg)}$ = Absolute average dry gas meter temperature, °R

$T_{s(avg)}$ = Absolute average stack temperature, °R

T_{std} = Standard absolute temperature, 528 °R (68 °F)

θ = Total sampling time, min.

V_{lc} = Total volume of liquid collected in impingers and silica gel, ml

V_m = Volume of gas sample as measured by dry gas meter, CF

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

$V_{w(std)}$ = Volume of water vapor in the gas sample corrected to standard conditions, SCF

$\bar{V}_s$ = Average actual stack gas velocity, FT/SEC

vp_{tdb} = Vapor pressure at T_{db}, IN. HG.

vp_{twb} = Vapor pressure at T_{wb}, IN. HG.

$\overline{\Delta H}$ = Average pressure differential across the orifice meter, IN. WC.

ΔP = Velocity pressure of stack gas, IN. WC.

γ = Dry test meter correction coefficient, dimensionless

ρ = Actual gas density, LB/ACF

METHOD 3
CALCULATION EQUATIONS

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

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

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

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

METHOD 5
CALCULATION EQUATIONS

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

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

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

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

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

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

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

CALCULATION EQUATIONS

METHOD 7

$$V_{m(std)} = 17.64\ (V_f - 25)\ [\frac{P_f}{T_f} - \frac{P_i}{T_i}]$$

$$C_s = 6.243 \times 10^{-5}\ \frac{M}{V_{m(std)}}$$

$$E = \frac{2090\ C_s F}{20.9 - \overline{B}'_{O_2}}$$

$$C_s\ (GR/DSCF) = 7000\ C_s$$

$$C_s\ (MG/DSCM) = 1.60186 \times 10^7\ C_s$$

$$C_s\ (ppm\text{-}dry) = 8.37552 \times 10^6\ C_s$$

$$C_s\ (ppm\text{-}3\%\ O_2) = 8.37552 \times 10^6\ C_s\ \{1 + [\frac{\overline{B}'_{O_2} - 3}{20.9 - B'_{O_2}}]\}$$

$$C_s\ (ppm\text{-}wet) = 8.37552 \times 10^6\ C_s\ (1 - \frac{MC}{100})$$

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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/10^6BTU

F = F-Factor for given fuel type, DSCF/10^4BTU

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

CALCULATION EQUATIONS

METHOD 10

$$CO{\cdot}PPM{\cdot}DRY = CO_{CO_2} - free,\ dry,\ avg\ (1 - CO_2,\ d/100)$$

$$CO{\cdot}PPM{\cdot}WET = CO{\cdot}PPM{\cdot}DRY\ (1 - MC/100)$$

$$GR/DSCF = 5.0885\ X\ 10^{-4}\ (CO{\cdot}PPM{\cdot}DRY)$$

$$mg/dscm = 1.165\ (CO{\cdot}PPM{\cdot}DRY)$$

$$\dot{m} = 8.5714\ x\ 10^{-3}\ (GR/DSCF)\ (Q_{s,d})$$

$$E = \frac{2.9857\ x\ 10^{-3}\ F_d\ (GR/DSCF)}{20.9 - O_{2,d}}$$

where:

CO_{CO_2} - *free, dry, avg*

= average of two determinations of carbon monoxide on a dry, CO_2 - free integrated flue gas sample reported in ppm by volume

$CO_{2,d}$ = carbon dioxide concentration of flue gas on a dry percent by volume basis

$O_{2,d}$ = oxygen concentration of flue gas on a dry percent by volume basis

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MC = moisture content of flue gas on a percent by volume basis

CO·PPM·DRY = carbon monoxide concentration in ppm by volume on a dry basis

CO·PPM·WET = carbon monoxide concentration in ppm by volume on a wet or actual basis

GR/DSCF = concentration of carbon monoxide in flue gas on a grains per dry standard cubic foot basis (68 °F, 29.92 IN. HG.)

mg/dscm = concentration of carbon monoxide in flue gas on a milligrams per dry standard cubic meter basis (60 °F, 29.92 IN. HG.)

$\dot{m}$ = emissions or mass rate of carbon monoxide on a LB/HR basis

$Q_{s,d}$ = volumetric flow rate of flue gas in dry standard cubic feet per minute

E = emission factor of carbon monoxide in pounds of carbon monoxide emitted per million BTU heat input (LB/MMBTU)

F_d = F-Factor of respective fuel in dry standard cubic feet of exhaust gas at 0% oxygen per million BTU of heat input (DSCF/MMBTU)

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PM - 10 Equations

Preliminary Run Calculations:

$$Md = 0.44\ B_{CO_2} + 0.32\ B_{O_2} + 0.28\ (B_{N_2} + B_{CO})$$

$$M_s = M_d\ (1 - \frac{MC}{100}) + 0.18\ (MC)$$

$$P_s = P_b + \frac{P_g}{13.6}$$

$$\mu = 152.418 + 0.2552\ t_s + 3.2355\ x\ 10^{-5}\ t_s^2 + 0.53147\ (B_{O_2}) - 0.74143\ MC$$

$$Q_s = 2.837\ x\ 10^{-3}\ \mu\ [\frac{(t_S + 460)}{(M_s P_s)}]^{0.2949}$$

$$\Delta H = \frac{1.083\ (t_m + 460)\ M_d \Delta H@}{P_b} [\frac{Q_s\ (1 - \frac{MC}{100})\ P_s}{t_s + 460}]^2$$

$$\Delta_p^{M201A} = \Delta_P^{M2}\ (\frac{C_P^{M_2}}{C_P^{M201A}})^2$$

Dwell Times:

First point

$$\Delta t_1 = [\frac{\sqrt{\Delta \acute{P}_i}}{(\sqrt{\Delta \acute{P}})_{AVG}}]$$

Other points

$$\Delta t_n = (\frac{\Delta t_1}{\sqrt{\Delta P_1}}) \sqrt{\Delta P_n} \quad where\ n = 2,3,...,12$$

Post Test Calculations:

$$V_{m(std)} = 17.64\ \gamma\ V_m\ (\frac{P_b + \frac{\Delta \overline{H}}{13.6}}{\overline{t}_m + 460})$$

$$Q_s = \frac{5.669\ x\ 10^{-2}\ (\overline{t}_s + 460)}{\theta\ P_s}\ [V_{m(std)} + 0.04707\ (V_f - V_i)]$$

$$\mu = 152.418 + 0.2552\ \overline{t}_s + 3.2355\ x\ 10^{-5}\ \overline{t}_s^2 + 0.53147\ B_{O_2} - 0.74143\ MC$$

$$M_s = M_d\ (1 - \frac{MC}{100}) + 0.18\ MC$$

$$D_{50} = 0.15625\ (\frac{\overline{t}_s + 460}{M_s P_s})^{0.2091}\ (\frac{\mu}{Q_s})^{0.7091}$$

where:

M_d - dry molecular weight of exhaust gas

B_{CO2} - percent volume of CO_2 in exhaust gas on a dry basis

B_{O2} - percent by volume of O_2 in exhaust gas on a dry basis

B_{N2} - 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

$Q_{s(std)}$ - 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 - dwell time at traverse point n, where n - 2,3,...12, minutes

Δt_1 - dwell 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

Y - dry test meter coefficient, dimensionless

$\overline{\Delta H}$ - 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

METHOD 25A

Total Gaseous Organics Calculation Equation

GR C/SCF = 2.180×10^{-4} (ppm, w)

GR C/DSCF = 2.180×10^{-4} (ppm, w)/(1-MC/100)

LB C/HR = 8.5714×10^{-3} (GR/DSCF) (DSCFM)

where:

GR C/SCF = grains of total gaseous organics as carbon per actual (wet) standard cubic foot

GR C/DSCF = grains of total gaseous organics as carbon per dry standard cubic foot

LB C/HR = pounds of total gaseous organics as carbon emitted per hour

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$$lb/hr = \frac{ppm}{1 \times 10^6} \times acfm \times 60 \times \frac{mw}{357}$$

Note 1: The Rati is normally operated with a heated
filter, sa pm, w.

Note 2: ppm, C =

CALCULATION EQUATIONS

Chromotropic Acid Method for Formaldehyde

$$m_t = \frac{m_a \, V_{soln}}{V_{aliq}}$$

where:

m_t = mass of formaldehyde in total sample in ug

m_a = mass of formaldehyde in aliquot in ug

V_{soln} = volume of total sample in cc (500 cc normally)

V_{aliq} = volume of aliquot taken for analysis in cc

PPM·DRY = $\frac{0.0283 \, m_t}{V_{std}}$

PPM·WET = PPM.DRY (1-MC/100)

GR/DSCF = 5.45×10^{-4} (PPM·DRY)

mg/dscm = 1.249 (PPM·DRY)

$\dot{m}$ = 8.5714×10^{-3} (GR/DSCF) ($Q_{s,d}$)

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)

V_{std} = dry gas volume as measured by the dry gas meter, corrected to standard conditions (at 68 °F and 1 atmosphere) DSCF

EPA Method 202 Calculations Report No. 4-3252

Job: **LOUISIANA PACIFIC - DUNGANNON**
Date: 28-Jun-94
Thermal Oil Heater

RUN	Vic (ml)	Sulfate (mg/ml)	Mc (mg)	Mr (mg)	Mi (mg)	Mo (mg)	Mb (mg)	CPM (mg)	**ENTER IN COMPUTER** (g)
1	250	1.38E-03	0.06	13.6	13.54	9.9	0.6	22.84	0.022837
2	250	1.19E-03	0.05	11.4	11.35	9.2	0.6	19.95	0.019945
3	250	1.09E-03	0.05	8.3	8.25	1.6	0.6	9.25	0.00925

EPA Method 201A/202 Totals

RUN	Probe (mg)	Filter (mg)	CPM (mg)	Total (mg)
1	26.9	9	22.84	58.73652
2	21.7	11.5	19.95	53.14526
3	17.2	9.4	9.25	35.84986

[redacted]

Date: 28-Jun-94
Dryer Stack

RUN	Vic (ml)	Sulfate (mg/ml)	Mc (mg)	Mr (mg)	Mi (mg)	Mo (mg)	Mb (mg)	CPM (mg)	**ENTER IN COMPUTER** (g)
1	250	1.27E-03	0.06	16.6	16.54	11.6	0.6	27.54	0.027542
2	250	1.69E-04	0.01	6.9	6.89	6	0.6	12.29	0.012292
3	250	1.92E-04	0.01	16.6	16.59	15.4	0.6	31.39	0.031391

EPA Method 201A/202 Totals

RUN	Probe (mg)	Filter (mg)	CPM (mg)	Total (mg)
1	57.6	53.5	27.54	138.6416
2	20.3	53.2	12.29	85.79223
3	19.3	62.1	31.39	112.7912

Report No. 4-3252

LOUISIANA PACIFIC - DUNGANNON

Total HydroCarbons Calculations

Dryer Stack

TEST #	RUN	MC%	CONC (ppmC,w)	GASFLOW (DSCFM)	MASSRATE (LB/HR)	AVERAGE (ppmC,w)	AVERAGE (LB/HR)		(GR/DSCF)
4	1	14	40	35770	3.11				0.0101395
	2	18.23	58	32630	4.32				0.0154629
	3	16.91	26	34790	2.03				0.0068215
						41.333333	3.155891		

Press Vent Stack

TEST #	RUN	MC%	CONC (ppmC,w)	GASFLOW (DSCFM)	MASSRATE (LB/HR)	AVERAGE (ppmC,w)	AVERAGE (LB/HR)		(GR/DSCF)
9	1	3.55	17.9	75017	2.60				0.0040458
	2	4.32	18.6	75380	2.74				0.0042379
	3	2.57	34.3	75816	4.99				0.0076746
						23.6	3.442324		

			LOUISIANA PACIFIC			Report No. 4-3252	
			Dunganon, Virginia				
Press Vent Stack			MDI CALCULATIONS				
	1,2PP METHOD						
TEST 8							
6/29/94							
	TIME	**Vstd**	**Mass**	**Flow**	**Conc**	**Conc**	**Mass Rate**
RUN #	(HRS)	(DSCF)	(ug)	DSCFM	(mg/Nm3)	ppm	(LB/HR)
1	0905-1009	43.6	206	75020	0.167	0.0160	0.046884
2	1101-1203	43.88	202	75380	0.163	0.0156	0.045899
3	1244-1347	42.82	132	75820	0.109	0.0105	0.030916
Avg					**0.146**	**0.0140**	**0.04123**
TEST 7	*NITRO - Normal Phase*						
6/29/94							
	TIME	**Vstd**	**Mass**	**Flow**	**Conc**	**Conc**	**Mass Rate**
RUN #	(HRS)	(DSCF)	(ug)	DSCFM	(mg/Nm3)	ppm	(LB/HR)
1	0905-1009	43.81		73900	#VALUE!	#VALUE!	#VALUE!
2	1101-1203	42.89		74420	#VALUE!	#VALUE!	#VALUE!
3	1244-1347	43.15		75610	#VALUE!	#VALUE!	#VALUE!
Avg					**#VALUE!**	**#VALUE!**	**#VALUE!**

		LP-Dungannon				
Dryer Stack					Report No. 4-3252	
		Oxides of Nitrogen				
		LB/HR Calculations				
RUN	**NOx ppm**	**Flow**	**LB/DSCF**	**LB/HR**		
1	18	21610	2.15E-06	2.786558		
2	37	21610	4.42E-06	5.727925		
3	7	21610	8.36E-07	1.083662		
		Carbon Monoxide				
		LB/HR Calculations				
RUN	**CO ppm**	**Flow**	**LB/DSCF**	**LB/HR**		
1	157	35770	1.14E-05	24.48303		
2	269	32630	1.95E-05	38.26626		
3	346	34790	2.51E-05	52.47799		

			LOUISIANA PACIFIC			Report No. 4-3252	
			Dunganon, Virginia				
Press Vent Stack			**MDI CALCULATIONS**				
	1,2PP METHOD						
TEST 8							
6/29/94							
	TIME	**Vstd**	**Mass**	**Flow**	**Conc**	**Conc**	**Mass Rate**
RUN #	(HRS)	(DSCF)	(ug)	DSCFM	(mg/Nm3)	ppm	(LB/HR)
1	0905-1009	43.6	206	75020	0.167	0.0160	0.046884
2	1101-1203	43.88	202	75380	0.163	0.0156	0.045899
3	1244-1347	42.82	132	75820	0.109	0.0105	0.030916
Avg					**0.146**	**0.0140**	**0.04123**
TEST 7	***NITRO - Normal Phase***						
6/29/94							
	TIME	**Vstd**	**Mass**	**Flow**	**Conc**	**Conc**	**Mass Rate**
RUN #	(HRS)	(DSCF)	(ug)	DSCFM	(mg/Nm3)	ppm	(LB/HR)
1	0905-1009	43.81	326	73900	0.263	0.0253	0.072737
2	1101-1203	42.89	301	74420	0.248	0.0238	0.069082
3	1244-1347	43.15	209	75610	0.171	0.0164	0.048441
Avg					**0.227**	**0.0218**	**0.06342**

APPENDIX N

SAMPLING TRAIN CALIBRATION DATA

INTERPOLL LABORATORIES

EPA Method 5 Gas Metering System

Quality Control Check Data Sheet

Job LP/Zimmerman Date 6-27-94

Operator Module No. 9

Instructions: Operate the control module at a flow rate equal to ^H@ for 10 minutes before attaching the umbilical. Record the following data:

Bar press 28.57 in. Hg. T = .9961 ^H@ 1.78 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
	(122.00)		
2.5	124.02	95	89
5.0	126.01	96	90
7.5	128.05	95	91
10	130.00	98	91
	V_m= 8.00	Avg(t_m)= 93.5 °F	

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(.9961)(\quad)}\left[\frac{(93.5 + 460)}{(28.57)}\right]^{0.5} \quad 4.4015$$

Y_{cn} = .9865

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. / Dungannon, VA Date 6-28-94

Operator M. Kaehler Module No. 5

Instructions: Operate the control module at a flow rate equal to ^H@ for 10 minutes before attaching the umbilical. Record the following data:

Bar press 28.72 in. Hg. γ = .9997 ^H@ 1.79 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
	(797.50)		
2.5	799.45	70	70
5.0	801.32	72	70
7.5	803.28	75	71
10	805.12	78	77
	V_m= 7.62	Avg(t_m)= 72.13 °F	

Calculate Y_{qa} as follows:

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

$$Y_{qa} = \frac{1.786}{(.9997)(7.62)}\left[\frac{(72.13) + 460}{(28.72)}\right]^{0.5}$$

Y_{qa} = 1.009

If Y_{qa} 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. / Dungannon, VA　　Date 6-29-94

Operator M. Kuehler　　Module No. 5

Instructions: Operate the control module at a flow rate equal to ^H@ for 10 minutes before attaching the umbilical. Record the following data:

Bar press 28.62 in. Hg. γ = .9997 ^H@ 1.79 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
	(79.90)		
2.5	81.95	81	80
5.0	83.90	85	81
7.5	85.89	88	81
10	87.94	91	81
	V_m = 7.94	Avg(t_m) = 83.50 °F	

Calculate Y_{qa} as follows:

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

$$Y_{qa} = \frac{1.786}{(.9997)(7.94)}\left[\frac{(83.50) + 460}{(28.62)}\right]^{0.5}$$

Y_{qa} = .981

If Y_{qa} 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 LP/DUNGANNON

Date 6-29-94

Operator

Module No. 9

Instructions: Operate the control module at a flow rate equal to ^H@ for 10 minutes before attaching the umbilical. Record the following data:

Bar press 28.62 in. Hg. τ = .9961 ^H@ 1.75 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
	(380.00)		
2.5	381.98	80	79
5.0	383.98	82	79
7.5	385.80	83	79
10	387.90	84	80
	V_m = 7.90	Avg(t_m) = 80.8 °F	

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(\quad)(\quad)}\left[\frac{(80.8) + 460}{(28.62)}\right]^{0.5} \quad 4.3469$$

Y_{cn} = .9865

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, Inc.
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: July 11, 1994

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

Date of Last Calibration: May 31, 1994
Calibration Technician: E. Trowbridge
Test Meter No.: American Meter AL-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
June 02, 1994	4-3024	137.00	276.53	139.53	139.53
June 14, 1994	4-3123	316.30	464.30	148.00	287.53
June 16, 1994	4-3124	474.40	575.95	101.55	389.08
June 21, 1994	4-3191	584.60	796.55	211.95	601.03
June 28, 1994	4-3252	805.40	1403.94	598.54	1199.57

* Total volume through meter since last calibration.

Interpoll Laboratories, Inc.
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: July 21, 1994

Meter Box No. : 9 (Rockwell Dry Test Meter Serial No. 964549)

Date of Last Calibration:	March 24, 1994
Calibration Technician:	E. Trowbridge
Wet Test Meter No.:	American Meter AL-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
April 06, 1994	4-2597	261.00	391.84	130.84	130.84
April 12, 1994	4-2649	400.30	612.20	211.90	342.74
May 10, 1994	4-2837	624.20	1606.81	982.61	1325.35
May 17, 1994	4-2893	1615.60	1826.77	211.17	1536.52
June 02, 1994	4-3068	1842.90	1989.75	146.85	1683.37
June 09, 1994	4-3097	1998.20	3111.64	1113.44	2796.81
June 28, 1994	4-3252	3130.30	3677.16	546.86	3343.67

* Total volume through meter since last calibration.

Date 5-31-94

Bar. Press. 29.12 in. Hg

INTERPOLL LABORATORIES, INC.
METER CALIBRATION SHEET
EPA METHOD 5

Control Module No. 5

Serial No. DTM 949230

Wet Test Meter No. AL-20

Technician

ΔH (in. WC)		Gas Volume Wet Test Meter (ft³)	* Cal. Index θ (%)	* Diff. Wet Test Meter ΔP_w (in.WC)	Gas Volume Dry test meter (ft³)		Gas temperatures			Time θ (min/sec)	Meter Coeff. Y	Orifice Const. ΔH@	C_f
nominal	actual				V_{di}	V_{df}	Wet Test t_w (°F)	Dry Test					
								t_{di} (°F)	t_{do} (°F)				
0.5	0.5	2	99.85	0.01	123.000	125.04	69	92	74	4/55	1.0035	1.70	
1.2	1.2	3	99.91	0.025	116.000	119.075	69	87	72	4/49	.9910	1.75	
2.0	2.0	3	99.93	0.055	119.500	122.572	69	94	74	3/50	.9983	1.83	
3.3	3.3	5	100.00	0.09	125.500	130.599	69	99	76	5/03	1.0062	1.84	
4.7	4.7	5	100.02	0.12	131.000	136.	69	103	77	4/13	.9994	1.85	
											.9997	1.79	

Positive leak check performed by

Meter was in tolerance ☒

Meter was not in tolerance ☐; readjusted linkage

Meter was not in tolerance ☐; changed dry test meters

Approved by Date 6/6/94

* Based on AL-20 wet test meter calibration in Nov. 1991 against Bell Prover (NBS Traceable) - Carl Poe Co.

Date 3-24-94

Bar. Press. 29.00 in. Hg

INTERPOLL LABORATORIES, INC.
METER CALIBRATION SHEET
EPA METHOD 5

Control Module No. 9
Serial No. DTM 964549
Wet Test Meter No. AL-20
Technician

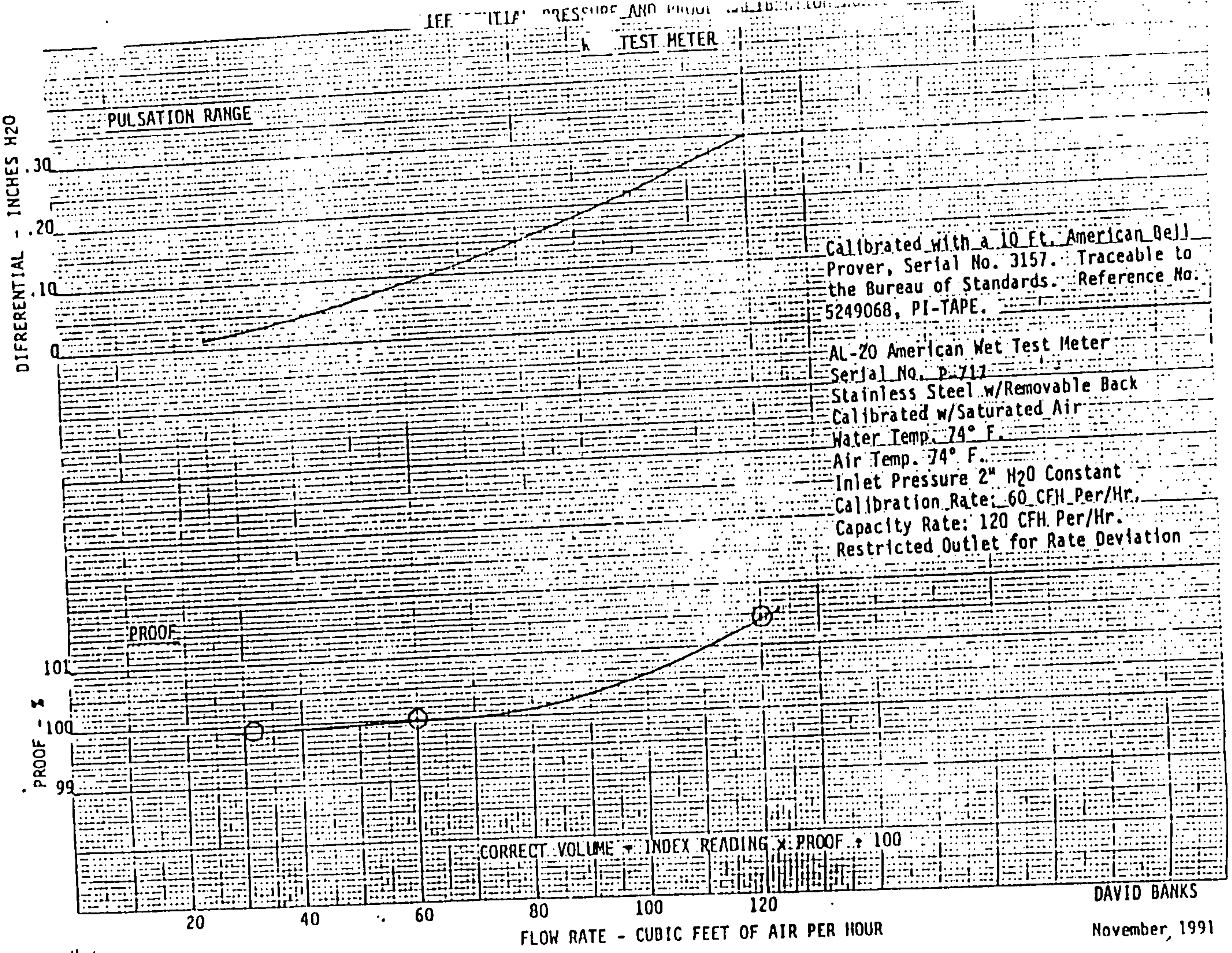
ΔH (in. WC)		Gas Volume Wet Test Meter (ft³)	* Cal. Index φ (%)	* Diff. Wet Test Meter ΔP_w (in.WC)	Gas Volume Dry test meter (ft³)		Gas temperatures			Time θ (min/sec)	Meter Coeff. Y	Orifice Const. ΔH@	C_f
							Wet Test	Dry Test					
nominal	actual				V_{di}	V_{df}	t_w (°F)	t_{di} (°F)	t_{do} (°F)				
0.6	.5	2	99.85	0.01	108.000	110.028	66	77	72	5/00	.9993	1.77	
1.2	1.2	3	99.91	0.025	104.500	107.530	66	74	70	4/49	.9973	1.76	
2.0	2.0	3	99.93	0.055	110.500	113.552	66	80	73	3/46	.9966	1.78	
3.3	3.3	5	100.00	0.09	114.000	119.118	66	84	75	4/55	.9934	1.79	
4.7	4.7	6	100.02	0.12	119.500	124.622	66	88	76	4/07	.9939	1.78	
	2	3	4	5	6	7	8	9	10	11/12	.9961	1.78	

Positive leak check performed by GT
Meter was in tolerance ☒
Meter was not in tolerance ☐; readjusted linkage
Meter was not in tolerance ☐; changed dry test meters

Approved by Date 4/4/94

* Based on AL-20 wet test meter calibration in Nov. 1991 against Bell Prover (NBS Traceable) - Carl Poe Co.

S0107OR 11/91



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 Wet 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" H_2O Constant
Calibration Rate: 60 CFH Per/Hr.
Capacity Rate: 120 CFH Per/Hr.
Restricted Outlet for Rate Deviation

CORRECT VOLUME = INDEX READING x PROOF ÷ 100

DAVID BANKS

November, 1991

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 06-28-94 Nozzle Number 6-4
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	.250
2	.250
3	.249
Average:	.250

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 06-28-94

Nozzle Number 7-3

Technician: Mark Kaehler

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

Position	Diameter (inches)
1	.185
2	.185
3	.185
Average:	.185

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 06-28-94 Nozzle Number
Glass-4
Technician: Mark Kaehler

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

Position	Diameter (inches)
1	.240
2	.238
3	.239
Average:	.239

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 06-28-94

Technician: Ed Trowbridge

Nozzle Number PM10-1

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	.210
2	.210
3	.211
Average:	.210

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 06-29-94 Nozzle Number 6-3
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	.186
2	.184
3	.185
Average:	.185

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 06-29-94 Nozzle Number
Glass-3
Technician: Mark Kaehler

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

Position	Diameter (inches)
1	.184
2	.184
3	.184
Average:	.184

Interpoll Laboratories, Inc.

Temperature Measurement Device Calibration Sheet

Unit under test:

Vendor Omega
Model HH 81 Serial Number 73JX1495
Range 0 - 2100 °F Thermocouple Type K
Date of Calibration 4-5-94 Technician Mark [illegible]

Method of Calibration:

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

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

Desired Temp (°F) Nominal	Temperature of Standard or Simulated Temp (°F)	Response of Unit Under Test (°F)	Deviation Δt (°F)	Deviation (%)
0	0	-1	1	.22
100	100	100	0	0
200	200	201	1	.15
300	300	300	0	0
400	400	399	1	.12
500	500	499	1	.10
600	600	601	1	.09
700	700	700	0	0
800	800	802	2	.16
900	900	901	1	.07
1000	1000	1001	1	.07
1100	1100	1100	0	0
1200	1200	1202	2	.12
1300	1300	1300	0	0
1400	1400	1402	2	.11
1500	1500	1500	0	0
1600	1600	1603	3	.15
1700	1700	1701	1	.05
1800	1800	1803	3	.13
1900	1900	1901	1	.04
2000	2000	2001	1	.04
2100	2100	2099	1	.04
		Averages:	1.05	.08

OF = off scale response by unit under test (°F)
% dev = 100 Δt / (460 + t)

☑ Unit in tolerance
☐ Unit was not in tolerance: recalibrated - See new calibration sheet.

S-433

E.T.'s

Interpoll Laboratories, Inc.

Temperature Measurement Device Calibration Sheet

Unit under test: #34

Vendor OMEGA

Model HH 81

Range 0-2000 °F

Date of Calibration 4-21-94

Serial Number 74TX C343

Thermocouple Type K

Technician E TROWBRIDGE

Method of Calibration:

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

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

Desired Temp (°F) Nominal	Temperature of Standard or Simulated Temp (°F)	Response of Unit Under Test (°F)	Deviation	
			Δt (°F)	(%)
0	0	-1.9	-1.9	.41
100	100	97.5	-2.5	.45
200	200	199.7	-.3	.05
300	300	297.5	-2.5	.33
400	400	397	-3	.35
500	500	498	-2	.20
600	600	600	—	0
700	700	699	-1	.08
800	800	801	+1	.08
900	900	900	—	0
1000	1000	1001	+1	.07
1100	1100	1098	-2	.13
1200	1200	1201	+1	.06
1300	1300	1299	-1	.05
1400	1400	1402	+2	.11
1500	1500	1500	—	0
1600	1600	1603	+3	.14
1700	1700	1701	+1	.05
1800	1800	1804	+4	.18
1900	1900	1901	+1	.04
2000	2000	2001	+1	.04
2100	2100	2099	-1	
		Averages:	1.46	.128

OF = off scale response by unit under test (°F)

% dev = 100 Δt / (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: #36
Vendor OMEGA
Model HH 81
Serial Number 7415X0344
Range -199°F - 2100°F °F
Thermocouple Type K
Date of Calibration 4-22-94
Technician K Rosenthal

Method of Calibration:

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

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

Desired Temp (°F) Nominal	Temperature of Standard or Simulated Temp (°F)	Response of Unit Under Test (°F)	Deviation	
			Δt (°F)	(%)
0	0	-3.5	3.5	.76
100	100	97	3	.54
200	200	198	2	.30
300	300	297	3	.39
400	400	397	3	.35
500	500	497	3	.31
600	600	599	1	.09
700	700	698	2	.17
800	800	800	0	.0
900	900	900	0	0
1000	1000	999	1	.07
1100	1100	1098	2	.13
1200	1200	1200	0	0
1300	1300	1298	2	.11
1400	1400	1401	1	.05
1500	1500	1500	0	0
1600	1600	1602	2	.09
1700	1700	1701	1	.05
1800	1800	1803	3	.13
1900	1900	1901	1	.04
2000	2000	2001	1	.04
2100	2100	2099	1	.04
		Averages:		.172

OF = off scale response by unit under test (°F)
% dev = 100 Δt / (460 + t)

☒ Unit in tolerance
☐ Unit was not in tolerance: recalibrated - See new calibration sheet.

S-433

Interpoll Laboratories, Inc.
(612) 786-6020

S-Type Pitot Tube Inspection Sheet

Pitot Tube No. 22-6

Pitot tube dimensions:

1. External tubing diameter (D_t) .316 IN.
2. Base to Side A opening plane (P_A) .460 IN.
3. Base to Side B opening plane (P_B) .460 IN.

Alignment:

4. α_1 < 10° 0
5. α_2 < 10° 0
6. B_1 < 5° 0
7. B_2 < 5° 0
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 3.0 IN.
12. Pitot to thermocouple (parallel to probe) 3.0 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: 4-8-94

Inspected by:

CFR Title 40 Part 60 Appenidix A Method 2

S-348

Interpoll Laboratories, Inc.
(612) 786-6020

S-Type Pitot Tube Inspection Sheet

Pitot Tube No. 23-5

Pitot tube dimensions:

1. External tubing diameter (D_t) .316 IN.
2. Base to Side A opening plane (P_A) .460 IN.
3. Base to Side B opening plane (P_B) .460 IN.

Alignment:

4. α_1 < 10° 0
5. α_2 < 10° 0

6. B_1 < 5° 0
7. B_2 < 5° 0

8. Z <.125" .02
9. W <.0625" .01

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .760 IN.
11. Pitot to probe sheath 3.0 IN.
12. Pitot to thermocouple (parallel to probe) 3.0 IN.
13. Pitot to thermocouple (perpendicular to probe) .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: 2-8-94

Inspected by:

CFR Title 40 Part 60 Appenidix A Method 2

S-348

Interpoll Laboratories, Inc.
(612) 786-6020

S-Type Pitot Tube Inspection Sheet

Pitot Tube No. 23-6

Pitot tube dimensions:

1. External tubing diameter (D_t) .316 IN.
2. Base to Side A opening plane (P_A) .460 IN.
3. Base to Side B opening plane (P_B) .460 IN.

Alignment:

4. α_1 < 10° 0
5. α_2 < 10° 0

6. B_1 < 5° 0
7. B_2 < 5° 0

8. Z <.125" .02
9. W <.0625" .025

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .750 IN.
11. Pitot to probe sheath 3.0 IN.
12. Pitot to thermocouple (parallel to probe) 3.0 IN.
13. Pitot to thermocouple (perpendicular to probe) .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: 4-8-94

Inspected by:

CFR Title 40 Part 60 Appenidix A Method 2

S-348

Interpoll Laboratories, Inc.
(612) 786-6020

S-Type Pitot Tube Inspection Sheet

Pitot Tube No. MM-6

Pitot tube dimensions:

1. External tubing diameter (D_t) .316 IN.
2. Base to Side A opening plane (P_A) .460 IN.
3. Base to Side B opening plane (P_B) .460 IN.

Alignment:

4. α_1 < 10° 0
5. α_2 < 10° 0

6. B_1 < 5° 0
7. B_2 < 5° 0

8. Z <.125" .03
9. W <.0625" .025

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .750 IN.
11. Pitot to probe sheath 3.0 IN.
12. Pitot to thermocouple (parallel to probe) 3.0 IN.
13. Pitot to thermocouple (perpendicular to probe) .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: 4-8-94

Inspected by:

CFR Title 40 Part 60 Appenidix A Method 2

S-348

INTERPOLL LABORATORIES
(612)786-6020

Stack Sampling Department - QA
Aneroid Barometer Calibration Sheet

Date 9-13-93

Technician Mark Kaehler

Mercury Column Barometer No. LAB-1

Aneroid Barometer No. 560815

Actual Mercury Barometer Read	Ambient Temp.	Temperature Correction Factor	Adjsted Mercury Barometer Read	Initial Aneriod Barometer Read	Difference ($P_{ba}-P_{bm}$)
28.770	72	.114	28.656	28.760	.104

Has this barometer shown any consistent problems with calibration? Yes [✓ No] If yes, explain.

Has problem been alleviated? Yes/No. How?

*Note

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

S-312