#54

4-105

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RESULTS OF THE MARCH 11, 1993 MDI EMISSION COMPLIANCE TESTS AT THE LOUISIANA PACIFIC WAFERBOARD PLANT IN DUNGANNON, VIRGINIA

Submitted to:

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

Attention:

Sue Somers

Approved by:

Daniel J Despen

Daniel J. Despen
Manager
Field Testing Division

Report Number 3-8324
April 15, 1993
KE/kce

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APPENDICES:

ABBREVIATIONS

ACFM	actual cubic feet per minute
cc (ml)	cubic centimeter (milliliter)
DSCFM	standard cubic foot of dry gas per minute
DSML	dry standard milliliter
DEG-F (°F)	degrees Fahrenheit
DIA.	diameter
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.

1 INTRODUCTION

On March 11, 1993 Interpoll Laboratories personnel conducted MDI emission compliance tests on the Press Vent at the Louisiana Pacific Corporation (LP) Waferboard Plant located in Dungannon, Virginia. On-site testing was performed by M. Kaehler and R. Madison. Coordination between testing activities and plant operation was provided by Sue Somers of LP. The test was witnessed by C. Mosick of the Virginia Department of Air Pollution Control.

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". The Press Vent was tested at a MDI resin rate of 220 LB/HR and then again with a resin rate of 350 LB/HR.

MDI concentrations were determined in accordance with Interpoll Laboratories Method II-8791 (ver 1.1), which is based on NIOSH Method P&CAM 347 (N-p-nitrobenzyl-N-propylamine impregnated filters with analysis of the reaction product by HPLC). 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.

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 MDI samples. Each traverse point was sampled 2.5 minutes for a total sampling time of 60 minutes per run.

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

2 SUMMARY AND DISCUSSION

The important results of the MDI results for the Press Vent are presented in Table 1. The MDI concentration averaged 0.020 ppm,d at the 220 LB/HR resin rate and 0.031 ppm,d at the 350 LB/HR resin rate. The MDI emission rate averaged 0.064 LB/HR at the 220 LB/HR resin rate and 0.098 at the 350 LB/HR resin rate.

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

Table 1. Summary of the March 11, 1993 MDI Emission Compliance Test on the Press Vent at the Louisiana Pacific Waferboard Plant in Dungannon, Virginia.

Test/Run	Concentration (ppm,d)	Emission Rate (LB/HR)
(220 LB/HR Rate)		
1/1	.022	.068
1/2	.019	.058
1/3	.022	.066
Avg.	.021	.064
(350 LB/HR Rate)		
2/1	.027	.087
2/2	.033	.10
2/3	.032	.10
Avg.	.031	.096

3 RESULTS

The results of all field and laboratory evaluations are presented in this section. Gas moisture results are presented first followed by the computer printout of the MDI sampling data. 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 Gas Moisture Determinations

Test No. 1
Press Vent Stack

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

	Run 1	Run 2	Run 3
Date of run	03-11-93	03-11-93	03-11-93
Dry basis (orsat)			
carbon dioxide............	0.03	0.03	0.03
oxygen....................	20.90	20.90	20.90
nitrogen..................	79.07	79.07	79.07
Wet basis (orsat)			
carbon dioxide............	0.03	0.03	0.03
oxygen....................	20.73	20.64	20.71
nitrogen..................	78.42	78.10	78.35
water vapor...............	0.82	1.22	0.91
Dry molecular weight........	28.84	28.84	28.84
Wet molecular weight........	28.75	28.71	28.74
Specific gravity............	0.993	0.992	0.993

Test No. 2
Press Vent Stack

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

	Run 1	Run 2	Run 3
Date of run	03-11-93	03-11-93	03-11-93
Dry basis (orsat)			
carbon dioxide............	0.03	0.03	0.03
oxygen....................	20.90	20.90	20.90
nitrogen..................	79.07	79.07	79.07
Wet basis (orsat)			
carbon dioxide............	0.03	0.03	0.03
oxygen....................	20.67	20.66	20.67
nitrogen..................	78.18	78.18	78.19
water vapor...............	1.12	1.13	1.11
Dry molecular weight........	28.84	28.84	28.84
Wet molecular weight........	28.72	28.72	28.72
Specific gravity............	0.992	0.992	0.992

3.2 MDI Sampling Data

Test No. 1
Press Vent Stack

Results of MDI Sampling Data

	Run 1	Run 2	Run 3
Date of run	03-11-93	03-11-93	03-11-93
Time run start/end.....(HRS)	825/ 927	955/1056	1117/1218
Static pressure......(IN.WC)	-0.53	-0.53	-0.53
Cross sectional area (SQ.FT)	19.63	19.63	19.63
Pitot tube coefficient......	.840	.840	.840
Water in sample gas			
condenser............(ML)	0.0	0.0	0.0
impingers..........(GRAMS)	0.0	0.0	0.0
desiccant..........(GRAMS)	8.0	12.0	9.0
total..............(GRAMS)	8.0	12.0	9.0
Gas meter coefficient.......	1.0040	1.0004	1.0004
Barometric pressure..(IN.HG)	28.68	28.68	28.68
Avg. orif.pres.drop..(IN.WC)	1.84	1.87	1.89
Avg. gas meter temp..(DEF-F)	49.5	51.9	53.7
Volume through gas meter....			
at meter conditions...(CF)	45.55	46.08	46.46
standard conditions.(DSCF)	45.62	45.78	46.00
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.........(IN)	.184	.184	.184
Avg.stack gas temp ..(DEG-F)	77	77	77
Volumetric flow rate........			
actual..............(ACFM)	86511	86960	87499
dry standard.......(DSCFM)	80776	80805	81545
Isokinetic variation.....(%)	100.2	100.5	100.0

Test No. 2
Press Vent Stack

Results of MDI Sampling Data

	Run 1	Run 2	Run 3
Date of run	03-11-93	03-11-93	03-11-93
Time run start/end.....(HRS)	1255/1406	1427/1528	1550/1653
Static pressure......(IN.WC)	-0.53	-0.53	-0.53
Cross sectional area (SQ.FT)	19.63	19.63	19.63
Pitot tube coefficient......	.840	.840	.840
Water in sample gas			
condenser............(ML)	0.0	0.0	0.0
impingers..........(GRAMS)	0.0	0.0	0.0
desiccant..........(GRAMS)	11.0	11.0	11.0
total..............(GRAMS)	11.0	11.0	11.0
Gas meter coefficient.......	1.0004	1.0004	1.0004
Barometric pressure..(IN.HG)	28.68	28.68	28.68
Avg. orif.pres.drop..(IN.WC)	1.89	1.89	1.95
Avg. gas meter temp..(DEF-F)	57.6	66.3	67.8
Volume through gas meter....			
at meter conditions...(CF)	46.60	46.90	47.76
standard conditions.(DSCF)	45.79	45.32	46.03
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.........(IN)	.184	.184	.184
Avg.stack gas temp ..(DEG-F)	79	77	77
Volumetric flow rate........			
actual.............(ACFM)	87395	86379	87650
dry standard.......(DSCFM)	81078	80324	81514
Isokinetic variation.....(%)	100.1	100.0	100.1

APPENDIX A

RESULTS OF VOLUMETRIC FLOW RATE DETERMINATIONS

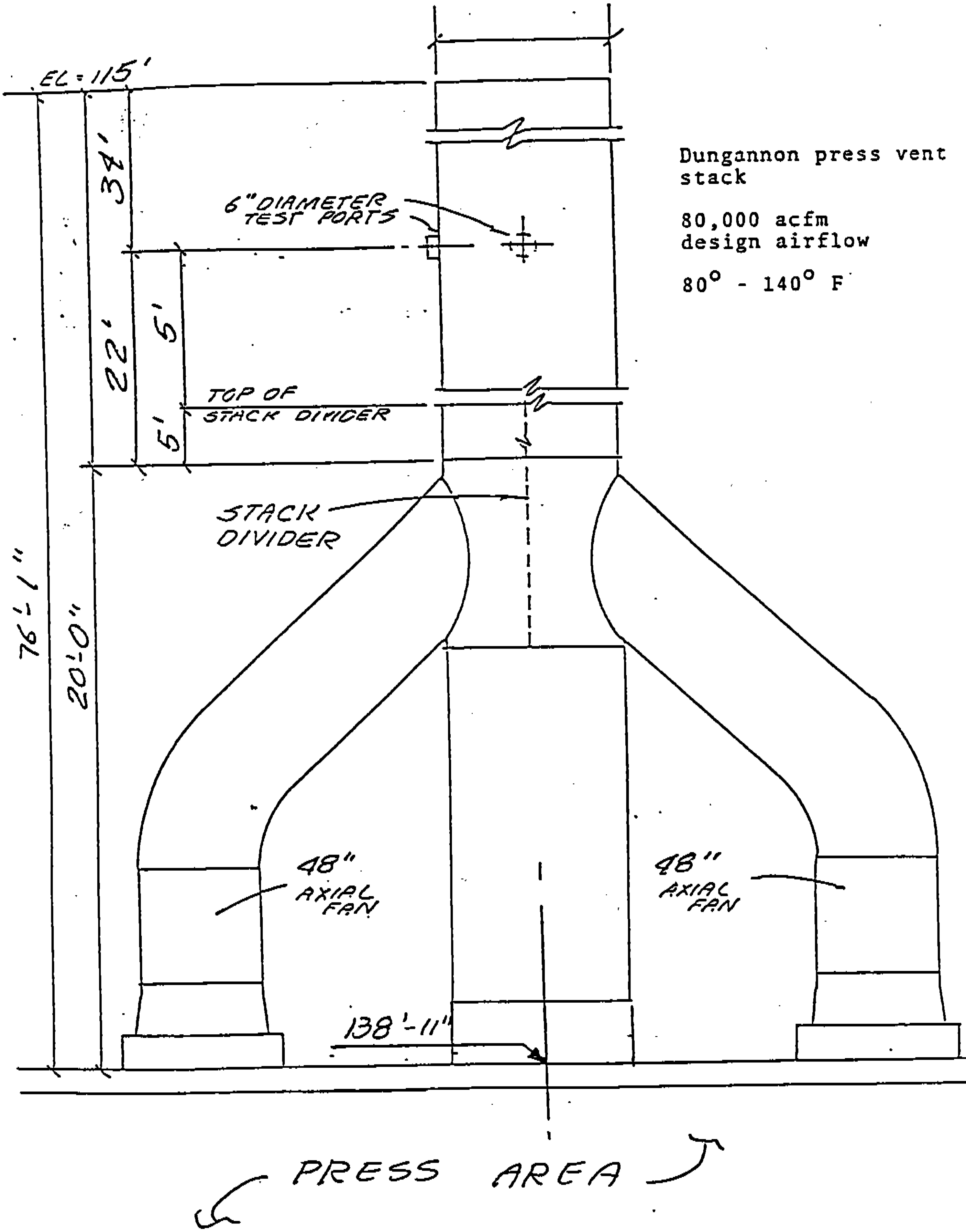
Test No. 1
Press Vent Stack

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

Date of Determination............	03-11-93
Time of Determination.......(HRS)	825
Barometric pressure.......(IN.HG)	28.68
Pitot tube coefficient...........	.84
Number of sampling ports.........	2
Total number of points...........	24
Shape of duct....................	Round
Stack diameter...............(IN)	60
Duct area.................(SQ.FT)	19.63
Direction of flow................	UP
Static pressure...........(IN.WC)	-.53
Avg. gas temp.............(DEG-F)	78
Moisture content..........(% V/V)	0.82
Avg. linear velocity.....(FT/SEC)	73.4
Gas density...............(LB/ACF)	.07015
Molecular weight......(LB/LBMOLE)	28.84
Mass flow of gas..........(LB/HR)	364011
Volumetric flow rate.............	
actual....................(ACFM)	86490
dry standard.............(DSCFM)	80588

APPENDIX B

LOCATION OF TEST PORTS



Dungannon press vent stack

80,000 acfm
design airflow

80° - 140° F

8-14-92

APPENDIX C

FIELD DATA SHEETS

INTERPOLL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job 6324

Source Press Vent / Stack

Test 1 Run 0 Date 3 11-93

Stack dimen. 60 IN.

Dry bulb 78 °F Wet bulb ___ °F

Manometer: ☐ Reg. ☒ Exp. ☐ Elec.

Barometric pressure 28.68 in Hg

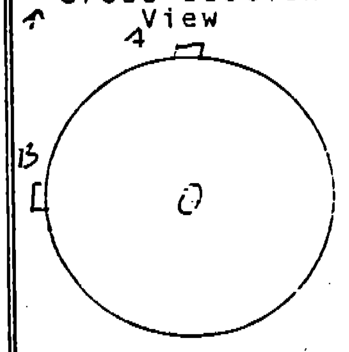
Static pressure -.53 in WC

Operators M. Kuehler & B. Madison

Pitot No. MDI-1 Cp .84

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 in.		Time start: 0925 hrs	
A-1	.021	1.26	7.26	1.60	
2	.067	4.02	10.02	1.62	
3	.118	7.08	13.08	1.65	
4	.177	10.62	16.62	1.60	
5	.250	15.00	21.00	1.51	
6	.356	21.36	27.36	1.48	
7	.644	38.64	44.64	1.40	
8	.750	45.00	51.00	1.61	
9	.823	49.38	55.38	1.59	
10	.882	52.92	58.92	1.73	↑
11	.933	55.98	61.98	1.91	
12	.979	58.74	64.74	1.85	78
B-1				1.55	↓
2				1.62	
3				1.70	
4				1.50	
5				1.50	
6				1.49	
7				1.38	
8				1.25	
9				1.45	
10				1.80	
11				1.99	
12				1.72	
Temp. meas. device & S/N: PDT-25 / TC				Time end: 0927 hrs	

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

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job 8324 Date 3-11-93 Test 1 Run 1
Source Press Vent / Stack No. of traverse points 24
Method MDI Filter holder: ERC Filter type: 2.5" G.F. (Treated

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: < 0.02 cfm at 5 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: NA

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

No. of probe wash bottles: 1
Sample recovered by: M. Kuehler + R. Mendison

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1421	1413	8
Total	▨	▨	8

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: ______

CF-023

NT LL DRA ES A METHOD 5 FIELD DATA SHEET

Job 83X4
Source Press Vent / Stack
Date 3-11-93 Test 1 Run 1

Operators M. Kaechler / M. Madison
Meter Box No. 2 ΔH@ 1.75 IN WC
Calibrator coeff. 1.0004

Pitot No. M01-1 Cp .84
Bar. Press. 28.68 inHg H2O 1 %
Nozzle No. A-3 Nozzle Dia .14 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Obs. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	(0825)	347.90											
B-12	2.5	349.90	1.72	1.93	9.83	3	76	NA	NA	40	48	44	20.9
11	5	351.97	1.99	2.26	1.93	3	76				45	43	20.9
10	7.5	353.95	1.80	2.04	3.92	3	75			40	47	39	20.9
9	10	355.68	1.45	1.63	5.70	2.5	78				48	39	20.9
8	12.5	357.44	1.25	1.41	2.36	2	78			40	49	40	20.9
7	15	359.16	1.38	1.56	9.10	2.5	78				51	40	20.9
6	17.5	360.94	1.49	1.69	0.92	2.5	77			40	53	41	20.9
5	20	362.76	1.50	1.71	2.75	2.5	77				54	42	20.9
4	22.5	364.60	1.50	1.71	4.58	2.5	77			40	54	41	20.9
3	25	366.58	1.70	1.93	6.53	3	78				56	42	20.9
2	27.5	368.45	1.62	1.85	8.43	2.5	79			40	56	42	20.9
1	30	370.34	1.55	1.77	0.29	2.5	78				57	43	20.9
A-12	32.5	372.40	1.85	2.11	2.33	3	78			40	55	43	20.9
11	35	374.42	1.91	2.17	4.40	3	78				58	45	20.9
10	37.5	376.43	1.73	1.98	6.38	3	78			40	59	44	20.9
9	40	378.35	1.69	1.94	8.33	3	77				60	45	20.9
8	42.5	380.30	1.61	1.85	0.25	2.5	76			41	61	45	20.9
7	45	392.04	1.40	1.61	2.04	2.5	76				61	46	20.9
6	47.5	393.92	1.48	1.71	3.98	2.5	76			41	61	46	20.9
5	50	395.72	1.51	1.74	5.74	2.5	76				61	46	20.9
4	52.5	387.66	1.60	1.85	2.65	3	76			41	60	46	20.9
3	55	399.58	1.65	1.90	9.54	3	76				60	47	20.9
2	57.5	391.54	1.62	1.92	1.52	3	76			41	62	46	20.9
1	60	393.45	1.60	1.85	3.44	3	76	↓	↓		62	47	20.9
	(0927)												
	θ = 60	Vm = 45.55		ΔH = 1.84							Avg. = 49.5		

S-0037R

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job 8324
Date 3-11-93 Test 1 Run 2
Source Press Vent / Stack
No. of traverse points 24
Method MDI Filter holder: ERC
Filter type: 2.5" G.F. (Treated

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: <0.02 cfm at 5 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: NA

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

No. of probe wash bottles: 1
Sample recovered by: M. Kaehler + R. Madison

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1317	1305	12
Total	▨	▨	12

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: ____

CF-023

CF-011

INTE[redacted]DLL [redacted]ABORA[redacted]IES [redacted]PA [redacted]DD [redacted]EL [redacted]TA [redacted]ET

Job 8324
Source A-255 Vent / Stack
Date 3-11-93 Test 1 Run 2

Operators M. Kuehlke & R. Madison
Meter Box No. 3 ΔH@ 1.79 IN WC
Gasmeter coeff. 1.0004

Pitot No. MDI-1 Cp .84
Bar. Press. 28.69 inHg H2O 5 %
Nozzle No. 6-3 Nozzle Dia .194 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	(0955)	393.60											
A-12	2.5	395.70	1.88	2.15	5.61	3	77	NA	NA	41	43	43	20.9
11	5	397.20	1.83	2.07	2.66	3	77				45	42	20.9
10	7.5	399.69	1.87	2.11	9.68	3	78			41	50	44	20.9
9	10	401.51	1.45	1.65	1.48	2.5	78				53	43	20.9
8	12.5	403.32	1.42	1.62	3.27	2.5	78			41	54	44	20.9
7	15	405.11	1.42	1.62	5.06	2.5	78				55	44	20.9
6	17.5	406.87	1.40	1.60	6.93	2.5	78			41	57	44	20.9
5	20	408.64	1.43	1.64	8.63	2.5	77				58	45	20.9
4	22.5	410.49	1.49	1.71	0.47	2.5	77			41	58	45	20.9
3	25	412.37	1.52	1.75	2.34	2.5	76				61	46	20.9
2	27.5	414.23	1.50	1.74	4.19	2.5	76			41	60	47	20.9
1	30	416.17	1.65	1.90	6.13	3	78				62	46	20.9
B-12	32.5	418.15	1.70	1.96	8.17	3	78			41	59	46	20.9
11	35	420.26	1.93	2.22	0.21	3	77				61	46	20.9
10	37.5	422.30	1.86	2.15	2.27	3	77			41	61	46	20.9
9	40	424.42	1.95	2.25	4.38	3	77				61	45	20.9
8	42.5	426.39	1.72	1.99	6.36	3	76			40	63	47	20.9
7	45	428.34	1.68	1.95	8.33	3	76				62	47	20.9
6	47.5	430.18	1.44	1.66	0.15	2.5	78			41	63	48	20.9
5	50	432.05	1.47	1.70	1.99	2.5	78				64	48	20.9
4	52.5	433.95	1.55	1.80	3.89	2.5	78			41	62	48	20.9
3	55	435.81	1.53	1.77	5.76	2.5	78				62	47	20.9
2	57.5	437.75	1.61	1.86	7.69	3	78			41	62	48	20.9
1	60	439.68	1.62	1.87	9.62	3	78	↓	↓		62	48	20.9
	(1056)												
	θ = 60	Vm = 46.08		ΔH = 1.87							Avg. = 51.9		

S-0037R

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job 8324 Date 3-11-93 Test 1 Run 3
Source Press Vent / Stack No. of traverse points 24
Method MM5 Filter holder: ERC Filter type: 1.5" G.F. (Tr[illegible]

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☑
Postest: < 0.02 cfm at 5 in. Hg. (vac) ☑

Particulate Catch Data:

No.s of filters used: nA

Recovery solvent(s)
☐ acetone
☑ other(s) Me Cl2

No. of probe wash bottles: 1
Sample recovered by: M. Kuchler & R. Madison

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1930	1921	9
Total	▨		9

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: ____

CF-023

IN OLL BOR ORIES EPA METHOD 5 FIELD DATA SHEET

Job 0324
Source Press Vent / Stack
Date 3-11-93 Test 1 Run 3

Operators M. Kachler R. Madison
Meter Box No. 2 ΔH@ 1.75 IN WC
Gasmeter coeff. 1.0004

Pitot No. MD1-1 Cp .84
Bar. Press. 25.68 inHg H2O 1 %
Nozzle No. E-3 Nozzle Dia .184 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dgs. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	(1112)	439.90											
B-12	2.5	442.07	1.99	2.28	2.02	3.5	78	NA	NA	41	48	46	20.9
11	5	444.18	2.00	2.27	4.12	3.5	78				50	46	20.9
10	7.5	446.13	1.75	1.99	6.10	3	78			41	54	46	20.9
9	10	448.11	1.72	1.96	8.06	3	78				54	46	20.9
8	12.5	449.77	1.25	1.43	9.74	2.5	77			41	57	46	20.9
7	15	451.53	1.33	1.53	1.48	2.5	77				58	47	20.9
6	17.5	453.39	1.47	1.69	3.31	3	77			41	59	45	20.9
5	20	455.22	1.50	1.73	5.17	3	77				62	48	20.9
4	22.5	457.07	1.52	1.76	7.03	3	77			41	59	47	20.9
3	25	458.98	1.60	1.84	8.94	3	77				63	48	20.9
2	27.5	460.89	1.58	1.83	0.85	3	77			41	63	50	20.9
1	30	462.77	1.60	1.85	2.72	3	77				61	47	20.9
A-12	32.5	464.98	2.05	2.36	4.94	4	77			41	61	49	20.9
11	35	467.12	2.00	2.30	7.08	3.5	78				62	48	20.9
10	37.5	469.23	1.92	2.21	9.17	3.5	78			42	64	49	20.9
9	40	471.23	1.72	1.99	1.16	3	78				64	49	20.9
8	42.5	473.21	1.71	1.98	3.15	3	78			42	65	50	20.9
7	45	475.17	1.60	1.86	5.08	3	75				65	50	20.9
6	47.5	476.93	1.39	1.62	6.96	3	75			42	65	51	20.9
5	50	478.80	1.54	1.79	8.77	3	78				61	50	20.9
4	52.5	480.66	1.51	1.75	0.64	3	78			42	66	51	20.9
3	55	482.56	1.51	1.75	2.51	3	78				66	50	20.9
2	57.5	484.51	1.65	1.91	4.47	3	78			42	66	51	20.9
1	60	486.36	1.58	1.75	6.30	3	78				68	51	20.9
	(1216)												
	θ = 60	Vm = 46.46		ΔH = 1.89							Avg. = 53.7		

S-0037R

INTERPOLL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job 8324

Source Press Vent / Stack

Test 2 Run 0 Date 3/1-93

Stack dimen. 60 IN.

Dry bulb 79 •F Wet bulb ___ •F

Manometer: ☑ Reg. ☐ Exp. ☐ Elec.

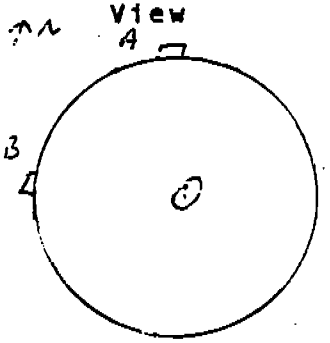
Barometric pressure 28.68 in Hg

Static pressure -.53 in WC

Operators M. Kuehler + R. Madison

Pitot No. MDI-1 Cp .84

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 in.		Time start: 1255 hrs	
A-1	.021	1.26	7.62	1.63	
2	.067	4.06	10.02	1.60	
3	118	7.08	13.08	1.62	
4	.177	10.62	16.62	1.57	
5	.250	15.00	21.00	1.52	
6	.356	21.36	27.36	1.49	
7	.644	38.64	44.64	1.47	
8	.750	45.00	51.00	1.59	
9	.823	49.38	55.38	1.63	
10	982	57.92	63.92	1.70	↑
11	.933	55.98	61.98	1.90	
12	.979	58.74	64.74	1.92	79
B-1				1.55	↓
2				1.57	
3				1.68	
4				1.69	
5				1.71	
6				1.50	
7				1.45	
8				1.43	
9				1.50	
10				1.80	
11				1.90	
12				1.06	
Temp. meas. device & S/N: PDT-25/TC				Time end: 1406 hrs	

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

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job 5324
Source Press Vent / Stack
Method MDI Filter holder: YERC
Date 3-1-93 Test 2 Run 1
No. of traverse points 24
Filter type: 2.5" G.F. (Treated)

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☑
Postest: < 0.02 cfm at 5 in. Hg. (vac) ☑

Particulate Catch Data:

No.s of filters used: NA

Recovery solvent(s)
☐ acetone
☑ other(s) MeCl$_2$

No. of probe wash bottles: 1
Sample recovered by: M. Kuehler + R. Madison

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1328	1317	11
Total	▨	▨	11

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: ____

CF-023

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job 6324
Source Press Vent / Stack
Date 3-11-93 Test 2 Run 1

Operators M. Buehler & R. Maclean
Meter Box No. 2 ^H@ 1.79 IN WC
Gasmeter coeff. 1.0004

Pitot No. MOT-1 Cp .84
Bar. Press. 28.68 inHg H2O 1 %
Nozzle No. 0-3 Nozzle Dia .181 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 (x v/v)
	(1255)	486.60											
A-12	2.5	488.20	1.86	2.14	0.65	3	78	NA	NA	41	49	49	20.9
11	5	490.27	1.90	2.16	0.72	3	78				52	49	20.9
10	7.5	492.72	1.82	1.97	2.69	3	77			42	56	49	20.9
9	10	494.58	1.45	1.66	4.50	2.5	79				56	48	20.9
8	12.5	496.21	1.23	1.41	6.17	2	79			43	59	48	20.9
7	15	497.97	1.33	1.53	2.91	2	79				60	48	20.9
6	17.5	499.78	1.42	1.63	9.71	2.5	80			43	61	48	20.9
5	20	501.59	1.62	1.86	1.83	2.5	79				57	51	20.9
4	22.5	503.44	1.53	1.75	3.10	2.5	80			43	62	51	20.9
3	25	505.51	1.70	1.96	5.48	3	80				64	51	20.9
2	27.5	507.47	1.68	1.94	2.44	3	80			43	67	52	20.9
1	30	509.46	1.70	1.97	9.43	3	80				69	53	20.9
B-12	32.5	511.67	2.02	2.35	1.60	3	79			43	68	53	20.9
11	35	513.80	1.96	2.28	3.74	3	79				69	53	20.9
10	37.5	515.93	1.89	2.21	5.85	3	77			43	70	54	20.9
9	40	517.97	1.70	1.99	2.85	3	72				70	54	20.9
8	42.5	519.88	1.68	1.96	9.84	3	79			43	70	54	20.9
7	45	521.81	1.57	1.76	1.72	2.5	79				70	55	20.9
6	47.5	523.72	1.58	1.84	3.65	2.5	79			43	70	54	20.9
5	50	525.62	1.50	1.75	5.53	2.5	78				71	55	20.9
4	52.5	527.49	1.50	1.76	7.42	2.5	78			43	72	58	20.9
3	55	529.41	1.58	1.95	9.35	3	79				73	57	20.9
2	57.5	531.27	1.58	1.77	1.20	2.5	79			43	72	56	20.9
1	60	533.20	1.60	1.88	3.15	3	77				73	58	20.9
	(1406)												
	θ = 60	Vm = 46.60		^H = 1.89							Avg. = 57.6		

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job 8324
Source Press vent / Stack
Method MDI Filter holder: ERC
Date 3-11-93 Test 1 Run 2
No. of traverse points 24
Filter type: 2.5" G.F. (Treated)

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☑
Postest: < 0.01 cfm at 6 in. Hg. (vac) ☑

Particulate Catch Data:

No.s of filters used: NA

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

No. of probe wash bottles: 1
Sample recovered by: M. Kaehler + R. Madison

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1441	1430	11
Total	▨	▨	11

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: ___

CF-023

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job 8324
Source Press Vent / Stack
Date 3-11-93 Test 2 Run 2

Operators M. Kuehler & R. Madison
Meter Box No. 2 ΔH@ 1.75 IN WC
Gasmeter coeff. 1.0004

Pitot No. MDI-1 Cp .84
Bar. Press. 28.60 inHg H2O 1 x
Nozzle No. B-3 Nozzle Dia. .184 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dgs. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Imp.	Gas/In	Gas/Out	Oxygen (xv/v)
	(1427)	533.40											
B-12	2.5	535.47	1.78	2.06	5.42	3	78	NA	NA	43	54	57	20.9
11	5	537.11	1.80	2.08	7.47	3	79				62	58	20.9
10	7.5	539.53	1.76	2.06	9.50	3	76			43	65	57	20.9
9	10	541.34	1.37	1.60	1.29	2.5	76				68	58	20.9
8	12.5	543.22	1.48	1.74	3.17	2.5	76			44	68	56	20.9
7	15	~~549~~545.04	1.38	1.62	4.98	2.5	76				70	58	20.9
6	17.5	546.81	1.33	1.56	6.76	2.5	78			44	71	58	20.9
5	20	548.65	1.42	1.67	8.54	2.5	78				72	59	20.9
4	22.5	550.49	1.48	1.74	0.48	2.5	77			44	73	59	20.9
3	25	552.37	1.45	1.71	2.34	2.5	77				73	59	20.9
2	27.5	554.30	1.50	1.77	4.24	3	77			44	74	60	20.9
1	30	556.18	1.62	1.91	6.21	3	77				75	60	20.9
A-12	32.5	558.45	2.02	2.38	8.41	3	78			44	74	60	20.9
11	35	560.65	1.94	2.29	0.57	3	78				74	60	20.9
10	37.5	562.70	1.82	2.15	2.66	3	76			44	76	61	20.9
9	40	564.82	1.87	2.21	4.79	3	78				76	61	20.9
8	42.5	566.84	1.63	1.93	6.77	3	78			43	77	61	20.9
7	45	568.84	1.68	1.99	8.78	3	78				76	62	20.9
6	47.5	570.67	1.42	1.68	0.64	2.5	78			43	77	62	20.9
5	50	572.53	1.41	1.67	2.49	2.5	78				78	63	20.9
4	52.5	574.41	1.48	1.76	4.39	2.5	77			43	77	62	20.9
3	55	576.31	1.50	1.78	6.30	3	77				77	62	20.9
2	57.5	578.19	1.61	1.91	8.27	4	78			43	77	63	20.9
1	60	580.30	1.68	1.99	0.29	4	78				77	63	20.9
	(1528)												
	θ = 60	Vm = 46.90		ΔH 1.89							Avg. = 66.3		

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job 8324
Source Press Vent / Stack
Method MDI Filter holder: ERi
Date 3-1-93 Test 2 Run 3
No. of traverse points 24
Filter type: 2.5" G.F. (Treated)

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☑
Postest: <0.02 cfm at 5 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: NA

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

No. of probe wash bottles: 1
Sample recovered by: M. Kuehler & B. Madison

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1339	1328	11 *
Total	▨	▨	11

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: ___

* Dry column was broken during tear down, this weight is an educated guess based on previous runs.

CF-023

CF-011

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job 8324
Source Press Vent (Stack)
Date 3-11-93 Test 2 Run 3

Operators M. Koehler + R. Madison
Meter Box No. 2 ΔH@ 1.77 IN WC
Gasmeter coeff. 1.0001

Pitot No. MDI-1 Cp .84
Bar. Press. 28.68 inHg H2O 1 %
Nozzle No. 1-3 Nozzle Dia. .184 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dvs. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (xv/v)
	(1550)	580.60											
A-12	2.5	582.78	1.88	2.21	2.72	3	78	NA	NA	43	61	60	20.9
11	5	584.84	1.84	2.14	4.79	3	78				64	60	20.9
10	7.5	586.85	1.69	1.97	6.78	3	78			43	67	60	20.9
9	10	588.84	1.69	1.98	8.79	3	78				69	60	20.9
8	12.5	590.82	1.68	1.97	0.78	3	78			43	71	60	20.9
7	15	592.58	1.32	1.56	2.56	2.5	78				72	60	20.9
6	17.5	594.49	1.58	1.86	4.51	3	77			43	72	61	20.9
5	20	596.38	1.55	1.83	6.44	3	77				73	61	20.9
4	22.5	598.18	1.37	1.62	8.25	2.5	77			43	74	60	20.9
3	25	600.15	1.52	1.80	0.17	3	77				75	61	20.9
2	27.5	602.17	1.69	2.00	2.19	3	77			43	75	61	20.9
1	30	604.22	1.68	1.99	4.20	3	77				78	62	20.9
B-12	32.5	606.43	1.97	2.34	6.38	3	78			43	74	62	20.9
11	35	608.58	1.95	2.30	8.55	3	78				75	62	20.9
10	37.5	610.73	1.89	2.24	0.69	3	77			43	77	62	20.9
9	40	612.89	1.85	2.20	2.80	3	77				77	63	20.9
8	42.5	614.77	1.54	1.83	4.74	2.5	77			43	77	62	20.9
7	45	616.76	1.68	1.99	6.76	3	77				77	63	20.9
6	47.5	618.68	1.47	1.75	8.65	2.5	77			43	78	63	20.9
5	50	620.60	1.44	1.71	0.52	2.5	78				78	63	20.9
4	52.5	622.51	1.52	1.80	2.45	2.5	78			43	78	64	20.9
3	55	624.42	1.54	1.83	4.39	2.5	77				78	64	20.9
2	57.5	626.39	1.60	1.90	6.36	2.5	77			43	78	64	20.9
1	60	628.36	1.60	1.91	8.34	2.5	76				78	64	20.9
	(1653)												
	θ = 60	Vm = 47.76		ΔH = 1.95							Avg. = 67.8		

S-0037R

APPENDIX D

INTERPOLL LABORATORIES ANALYTICAL RESULTS

INTERPOLL LABORATORIES, INC.
(612)786-6020

Louisiana-Pacific, Dungannon
Laboratory Log No. 8324

Results of MDI Analysis[1]

Test: 1
Source: Press Vent Stack
Sample Type: Impinger Catch

Sample Log No.	Sample Description	MDI Total ug
8324-01	Run 0 (Field Blank)	< 17
8324-02	Run 1	290
8324-03	Run 2	250
8324-04	Run 3	280

Sincerely,

INTERPOLL LABORATORIES, INC.

Wayne Olson

Wayne A. Olson, Manager
Organic Chemistry Group

WAO/cg

---

[1] Analysis performed by Method II-8791.

INTERPOLL LABORATORIES, INC.
(612)786-6020

Louisiana-Pacific, Dungannon
Laboratory Log No. 8324

Results of MDI Analysis[1]

Test: 2
Source: Press Vent Stack
Sample Type: Impinger Catch

Sample Log No.	Sample Description	MDI Total ug
8324-05	Run 1	370
8324-06	Run 2	440
8324-07	Run 3	440

Sincerely,

INTERPOLL LABORATORIES, INC.

Wayne A Olson

Wayne A. Olson, Manager
Organic Chemistry Group

WAO/cg

---

[1] Analysis performed by Method II-8791.

Interpoll Laboratories
(612) 786-6020

Chain of Custody
Sample Deposition Sheet

Job 8324
Team Leader M. Kuehler
Date Submitted 3-15-93
Test No. 1

Source Press Vent
Test Site Stack
Date of Test 3-11-93
No. of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Comments
3+1	Probe Wash: ☐ Acetone ☐ D.I. Water ☒ $MeCl_2$	☐ As per EPA M-5 ☒ Other MDI	
3+1	Filter: ☐ 4" G.F. ☐ S.S. Thimble ☒ 2.5" G.F. ☐ 47 mm G.F.	☐ As per EPA M-5 ☐ As per EPA M-17 ☒ Other MDI	Added to Probe Wash Bottle
–	Impinger Catch: ☐ D.I. Water ☐ 3% H_2O_2 ☐ 4M5 Hg Only ☐ 4M5 Metals ☐ 1.0 N NaOH ☐ Other	☐ MN Protocol ☐ WI Protocol ☐ EPA M-6 or 8 ☐ Acid Gases ☐ Formaldehyde ☐ Metals ☐ Other	
–	Integrated Gas sample	☐ As per EPA M-3 ☐ As per EPA M-10 ☐ Other	Ambient Air
–	Oxides of Nitrogen (NO_x)	☐ As per EPA M-7A ☐ Other	Date Time (HRS)
–	☐ Fuel Sample ☐ Aggregate	☐ Attached fuel Form #S-0163RRR	
–	Particle Size	☐ X-Ray Sedigraph ☐ Bahco Method ☐ Other	
–	Audit Samples ☐ Sulfur Dioxide ☐ Oxides of Nit. ☐ Other	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other	

Source Information

1) Type of Source: ☐ Boiler ☐ Asphalt Plant ☐ Incinerator ☐ Dryer
☒ Other Press (wood)
2) Fuel: ☐ Coal ☐ Wood ☐ Gas ☐ Oil ☐ RDF ☐ Other NA
3) Is sample combustible? ☒ No ☐ Yes
4) Does sample need special handling? ☒ No ☐ Yes If yes, explain

S-278RRRR

Interpoll Laboratories
(612) 786-6020

Chain of Custody
Sample Deposition Sheet

Job 8324
Team Leader M. Baehler
Date Submitted 3-15-93
Test No. 2

Source Press Vent
Test Site Stack
Date of Test 3-11-93
No. of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Comments
3	Probe Wash: ☐ Acetone ☐ D.I. Water ☒ MeCl₂	☐ As per EPA M-5 ☒ Other MDI	
3	Filter: ☐ 4" G.F. ☐ S.S. Thimble ☒ 2.5" G.F. ☐ 47 mm G.F.	☐ As per EPA M-5 ☐ As per EPA M-17 ☒ Other MDI	Added to Probe Wash
–	Impinger Catch: ☐ D.I. Water ☐ 3% H_2O_2 ☐ 4M5 Hg Only ☐ 4M5 Metals ☐ 1.0 N NaOH ☐ Other	☐ MN Protocol ☐ WI Protocol ☐ EPA M-6 or 8 ☐ Acid Gases ☐ Formaldehyde ☐ Metals ☐ Other	
–	Integrated Gas sample	☐ As per EPA M-3 ☐ As per EPA M-10 ☐ Other	Ambient Air
–	Oxides of Nitrogen (NO_x)	☐ As per EPA M-7A ☐ Other	Date Time(HRS)
–	☐ Fuel Sample ☐ Aggregate	☐ Attached fuel Form #S-0163RRR	
–	Particle Size	☐ X-Ray Sedigraph ☐ Bahco Method ☐ Other	
–	Audit Samples ☐ Sulfur Dioxide ☐ Oxides of Nit. ☐ Other	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other	

Source Information

1) Type of Source: ☐ Boiler ☐ Asphalt Plant ☐ Incinerator ☐ Dryer ☒ Other Press Vent (Wood)
2) Fuel: ☐ Coal ☐ Wood ☐ Gas ☐ Oil ☐ RDF ☐ Other NA
3) Is sample combustible? ☒ No ☐ Yes
4) Does sample need special handling? ☒ No ☐ Yes If yes, explain

S-278RRRR

APPENDIX E

PROCESS RATE INFORMATION

DUNGANNON PRESS VENT TESTING 3–11–93
PROCESS DATA

CONTENTS PAGE

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF AIR POLLUTION CONTROL

DOCUMENT CERTIFICATION FORM

(see other side for instructions)

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering and evaluating the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE: DATE: 3/23/92

NAME: MARK BECKER

TITLE: ENVIRONMENTAL COORDINATOR

COMPANY: LOUISIANA-PACIFIC CORPORATION

PHONE: 715-634-3332

TEST SCHEDULE

PRESS VENT TESTING

TEST NO.	DATE	POLLUTANT	RUN #1	RUN #2	RUN #3
1 (220LB MDI/HR)	3-11	MDI	0825-0925	0955-1055	1117-1219
2 (350LB MDI/HR)	3-11	MDI	1255-1405	1427-1528	1550-1650

6a. PRESS OPERATING DATA:

6.a.1 Board thickness. 7/16"
6.a.2 Number of sheets produced per hour to be determined by press chart.
6.a.3 Pound of resin used per hour to be recorded.
6.a.4 Type of resin used to be recorded. MDI & LIQUID PHENOLIC
6.a.5 Press temperature to be recorded. 410° F
6.a.6 There are two exhaust fans.
6.a.7 Design airflow is 80,000 acfm. Actual acfm will be determined during sampling.
6.a.8 Tons of finished product produced during test will be determined by board weights and press charts.

4

DUNGANNON PRESS VENT TESTING 3-11-93

PROCESS DATA SUMMARY

PRESS VENT TESTING, 08:20-12:20
9.43 =PLANT PRODUCTION RATE IN TONS PER HOUR
220 =MDI RESIN USAGE RATE IN LBS PER HOUR
1.17% =MDI RESIN USAGE RATE IN % OF FINISHED PRODUCT
435 =LIQUID PHENOLIC RESIN USAGE IN LBS PER HOUR (100% SOLIDS)
2.30% =LIQUID PHENOLIC RESIN USAGE IN % OF FINISHED PRODUCT (100% SOLIDS)

PRESS VENT TESTING, 12:50-16:50
9.43 =PLANT PRODUCTION RATE IN TONS PER HOUR
350 =MDI RESIN USAGE RATE IN LBS PER HOUR
1.86% =MDI RESIN USAGE RATE IN % OF FINISHED PRODUCT
435 =LIQUID PHENOLIC RESIN USAGE IN LBS PER HOUR (100% SOLIDS)
2.30% =LIQUID PHENOLIC RESIN USAGE IN % OF FINISHED PRODUCT (100% SOLIDS)

DUNGANNON PRESS VENT TESTING 3-11-93
0820-1650

BOARD WEIGHTS - LBS
WEIGHTS OF APPROXIMATELY EVERY 25TH
UNTRIMMED BOARD FROM TAPES

191	193	186	187
184	193	191	191
205	196	187	190
187	187	181	184
203	189	192	192
188	184	190	200
196	194	196	196
188	194	188	189
191	196	196	192

191.31 LB = AVERAGE UNTRIMMED MAT WEIGHT

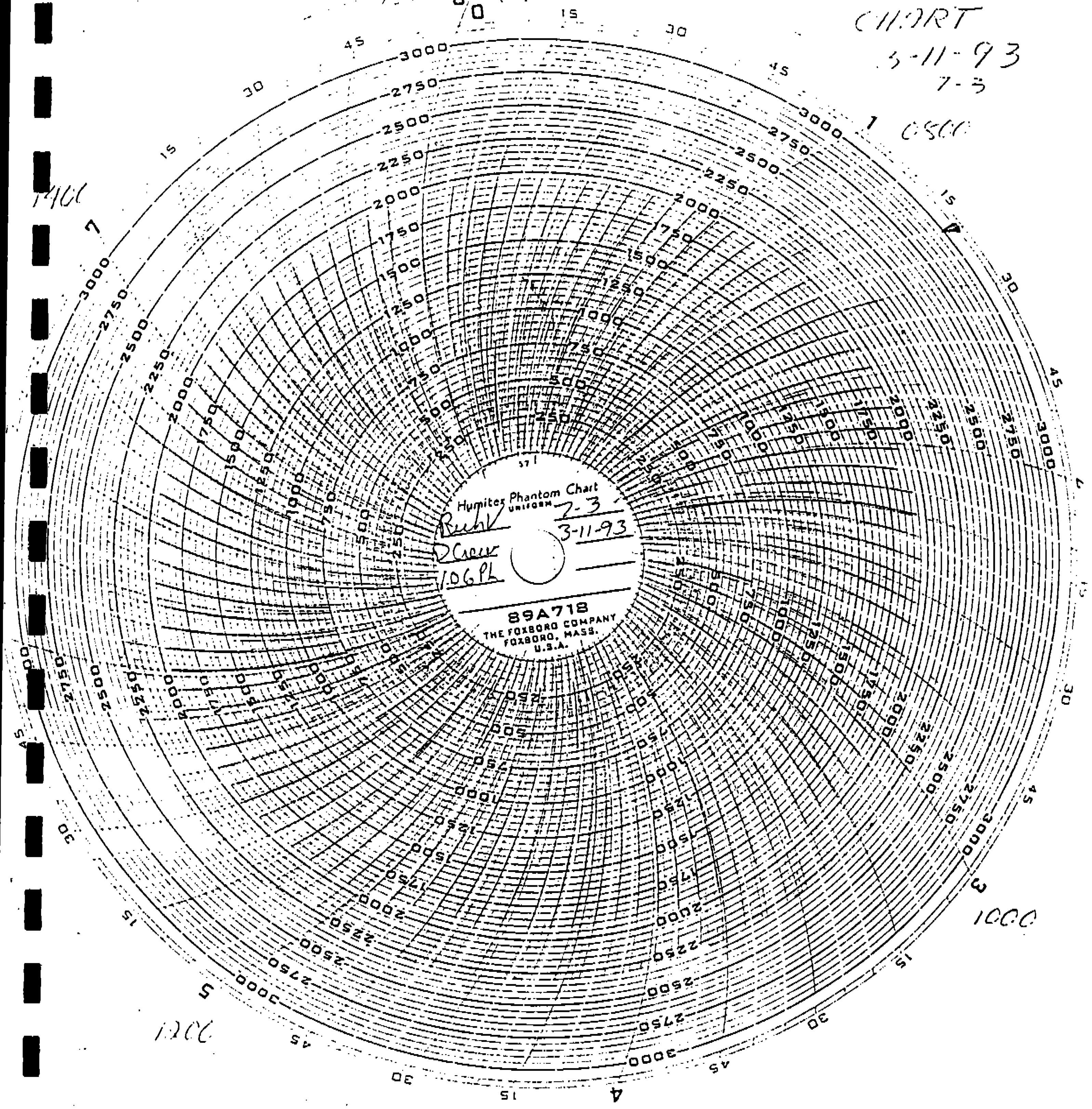
174.28 LB = AVERAGE FINISHED BOARD WEIGHT (UNTRIMMED MAT WEIGHT - TRIM WEIGHT)

8.9% = TRIM

PLANT PRODUCTION RATE

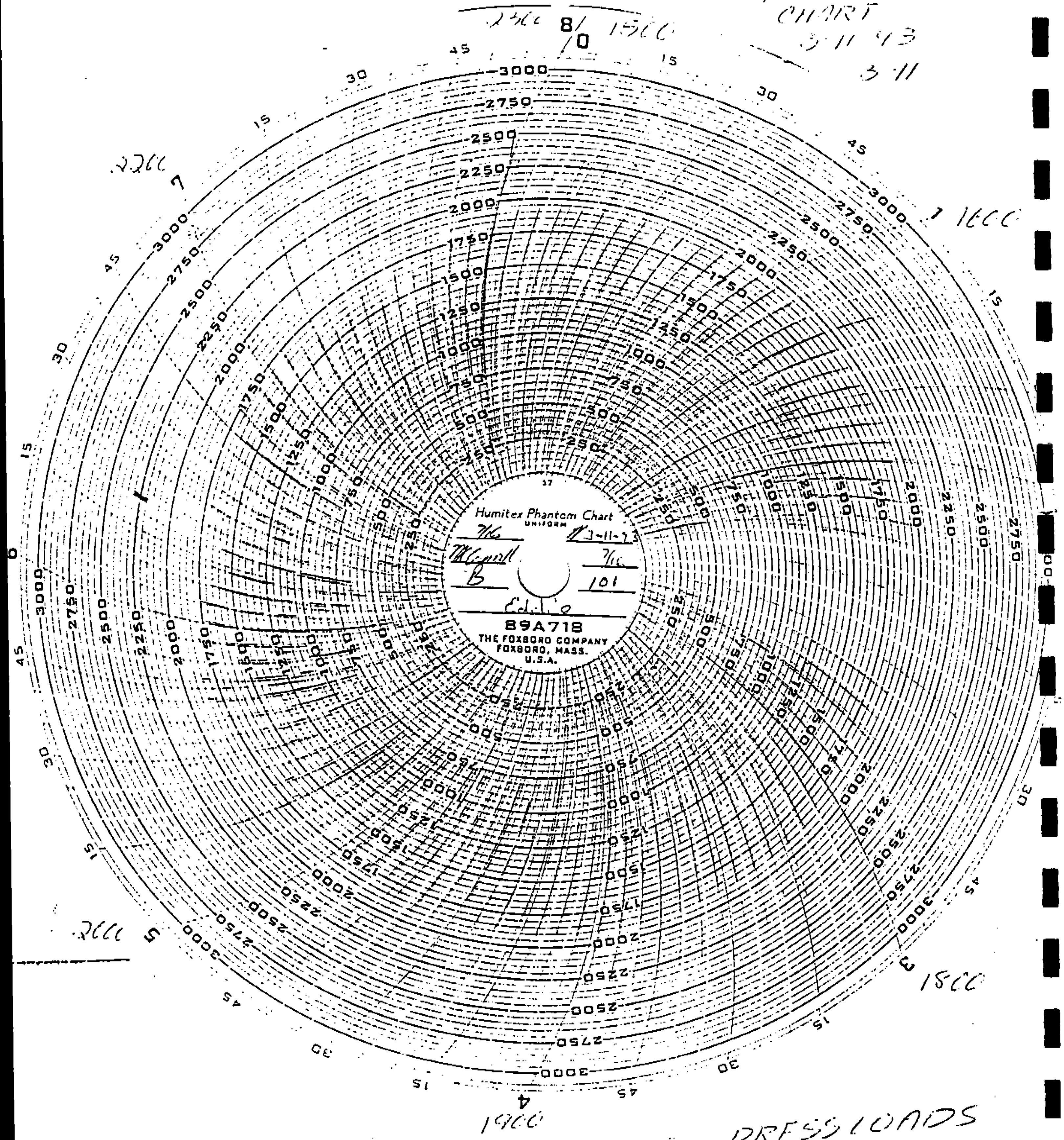
8.5 =HOURS DURING TESTING
115 =PRESSLOADS
920 =NO. OF (8' X 16') BOARDS PRODUCED (PRESSLOADS x 8 BOARDS/LOAD)
160338 =LBS FINISHED PRODUCT (BOARDS x WEIGHT OF FINISHED BOARD)
18863 =LBS FINISHED PRODUCT PRODUCED PER HOUR (LBS FINISHED PROD./TESTING HOURS)
9.43 =TONS FINISHED PRODUCT PRODUCED PER HOUR (LB FINISHED PROD PROD/HR / 2000 LB)

CHART
3-11-93
7-3



PRESSLOADS
0830 - 1500 =
90

CHART
3-11-93
3-11



PRESSLOADS
1500 - 1650 =
25

DUNGANNON, VIRGINIA

OPERATOR Rich V SHIFT 7-3 CREW D DATE 3-11-93

THICKNESS: 7/16

PRESS LOADS 106 = 126,635

OVERALL TIMER:

DECOMPRESSION TIME

PRESS TEMP: 410°

	CORE	SURFACE	mix
BEGIN	0	0	0
END	2046	6097	.556

LINE SPEED	FROM	TO
31/496	7:00	3:00

Cleaned Blender Shrouds & Tracks

Former hydraulic and radiater blown out

FCOS hydraulic unit and radiater blown out

Blender outfeed conv. tail pulleys cleaned

DOWNTIME		DOWNTIME (Mins.)			KEY	REASONS FOR DOWNTIME
FROM	TO	M	E	O		
9:42	9:45				3	E-Stop hit on #2 baghouse
11:32	11:34				2	unloader cage kicked out
1:51	1:52				1	dropped screen at bottom of #6

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)

UISIANA PACIFIC

NGANNON, VIRGINIA

ERATOR Eddie SHIFT 3-11 CREW B DATE 3-11-93

ICKNESS: 7/16 PRESS LOADS 101 120.665

ERALL TIMER: DECOMPRESSION TIME

RESS TEMP: 410

	CORE 33	SURFACE 20	min
BEGIN	2046	6097	586
END	3828	11309	1188

LINE SPEED	FROM	TO
496/31	3:00	5:09
480/20	5:09	11:00

Cleaned Blender Shrouds & Tracks

Former hydraulic and radiater blown out

FCOS hydraulic unit and radiater blown out

Blender outfeed conv. tail pulleys cleaned

DOWNTIME		DOWNTIME (Mins.)			KEY	REASONS FOR DOWNTIME
FROM	TO	M	E	O		
5:09	5:36	/			27	to fix ~~tall~~ TAIL pulley on short belt
7:56	7:57					at core blender
			/		1	unloader would not go down
9:55	9:57	/			2	#6 pulled out of the press
						30m total Down time

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)

16 E-10

DUNGANNON PRESS VENT TESTING 3-11-93
0820-1650

RESIN USAGE FROM FLOW CHARTS

0700-1215 220 = LBS OF MDI RESIN PER HOUR
18863 =LBS FINISHED PRODUCT PRODUCED PER HOUR DURING TESTING
1.17% = MDI RESIN USED AS % OF FINAL PRODUCT

1215-1703 350 = LBS OF MDI RESIN PER HOUR
18863 =LBS FINISHED PRODUCT PRODUCED PER HOUR DURING TESTING
1.86% = MDI RESIN USED AS % OF FINAL PRODUCT

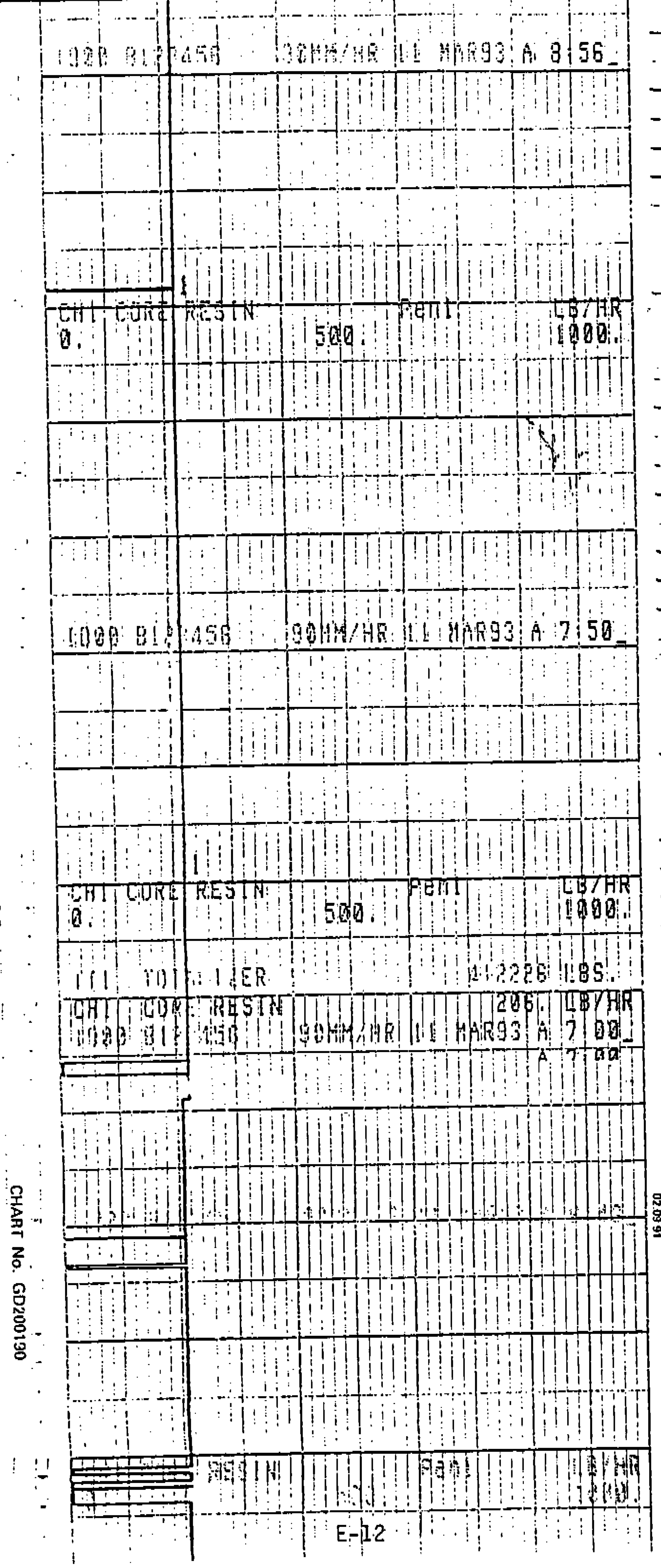
0716-1700 790 = LBS OF LIQUID PHENOLIC RESIN PER HOUR ON A 55% SOLIDS BASIS
435 = LBS OF LIQUID PHENOLIC RESIN PER HOUR ON A 100% SOLIDS BASIS
2.30% = LIQUID PHENOLIC RESIN USED AS % OF FINAL PRODUCT

WAX USAGE FROM DAILY INVENTORY SHEET

6774 = LBS OF WAX USED FOR THE DAY
335711 =PRODUCTION FOOTAGE FOR THE DAY - 3/8" BASIS
287752.2 =PRODUCTION FOOTAGE FOR THE DAY - 7/16" BASIS ((3/8" FOOTAGE)/ (7/16" / 3/8"))
2248 =NO OF 8'x16' BOARDS PRODUCED (7/16" FOOTAGE / (8'X16'))
174.28 =WEIGHT OF FINISHED 8'x16'7/16" BOARD
391792.7 = TOTAL LBS OF BOARD PRODUCED (NO. OF BOARDS x BOARD WEIGHT)
1.73% =WAX AS % OF FINAL PRODUCT

18863 =LBS FINISHED PRODUCT PRODUCED PER HOUR DURING TESTING
326 = LBS OF WAX USED PER HOUR DURING TESTING (% WAX x LBS FINISHED PRODUCT PER HOUR)

MDI


1000 B12456 90MM/HR 11 MAR93 A 8 56_
CH1 CORE RESIN 500. PCM1 LB/HR
0. 1000.
1000 B12456 90MM/HR 11 MAR93 A 7 50_
CH1 CORE RESIN 500. PCM1 LB/HR
0. 1000.
11 TOTALIZER 112226 LBS.
CH1 CORE RESIN 206. LB/HR
1000 B12456 90MM/HR 11 MAR93 A 7 00_
A 7 00
RESIN PCM1 LB/HR
1000.
CHART No. GD200190
02.09.91

12

MDI

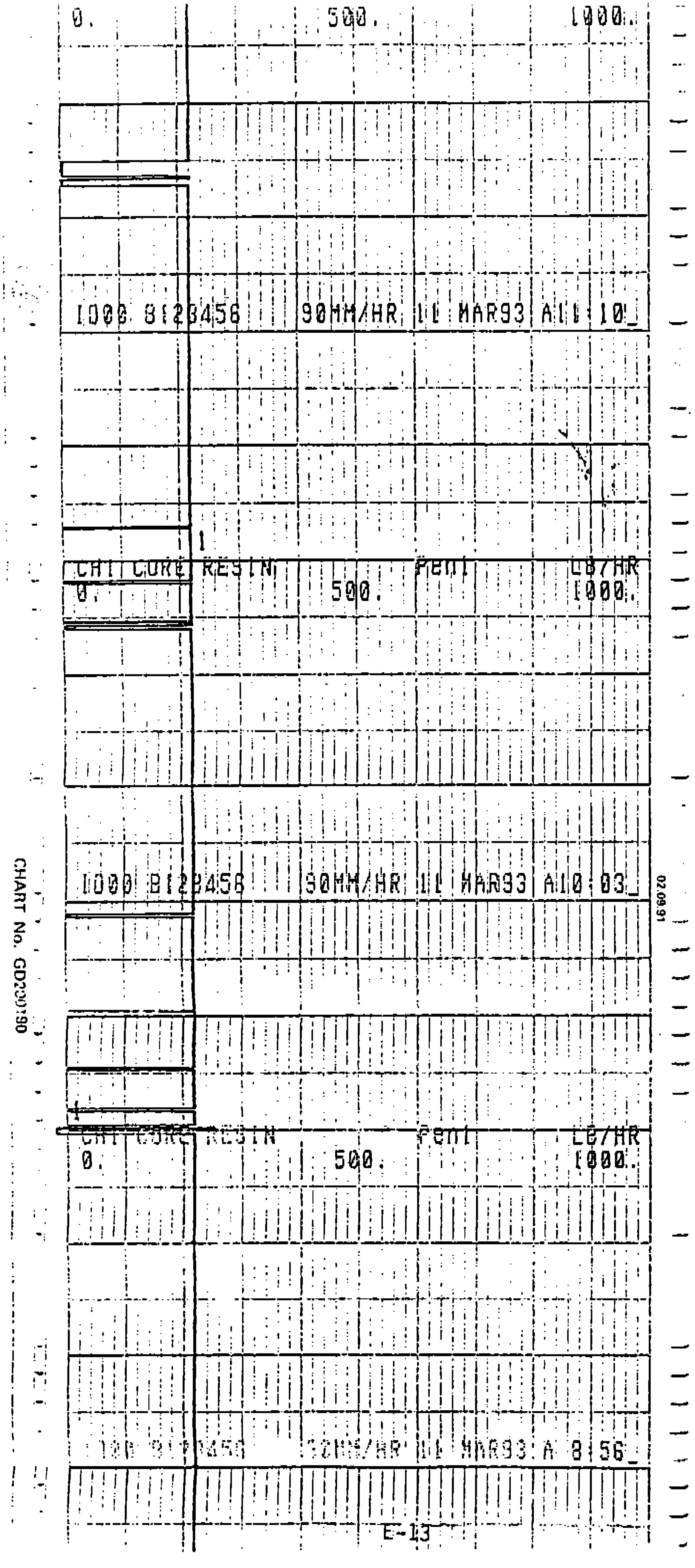

0.
500.
1000.
1000 B123456 90MM/HR 11 MAR93 A11 10_
1
CH1 CORE RESIN Pent LB/HR
0. 500. 1000.
1000 B123456 90MM/HR 11 MAR93 A10 03_
1
CH1 CORE RESIN Pent LB/HR
0. 500. 1000.
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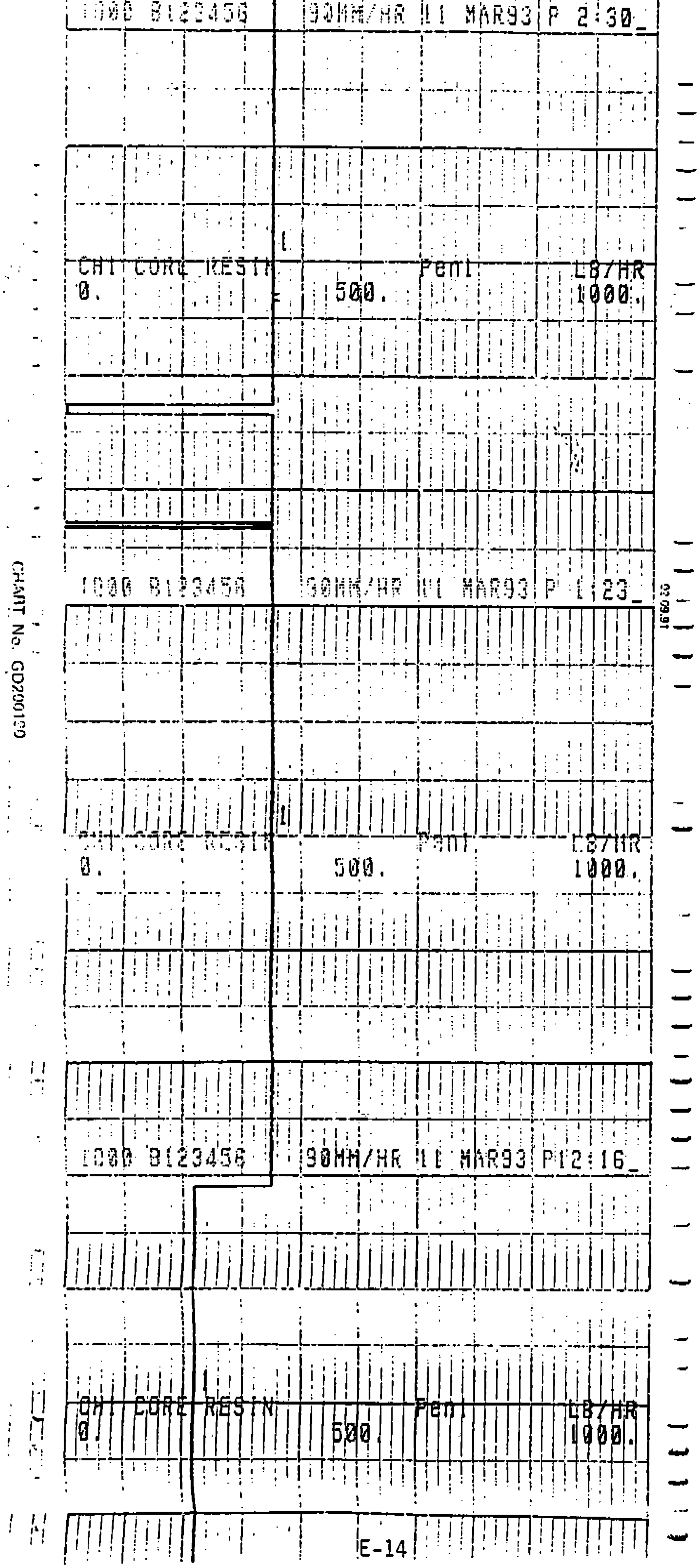
CHART No. GD290190
02091

13

MDI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CH1 CORE RESIN Pen1 LB/HR
0. 500. 1000.
1000 B123456 90MM/HR 11 MAR93 P 1:23_
CH1 CORE RESIN Pen1 LB/HR
0. 500. 1000.
1000 B123456 90MM/HR 11 MAR93 P12:16_
CH1 CORE RESIN Pen1 LB/HR
0. 500. 1000.
CHART No. GD200100

14

MD'

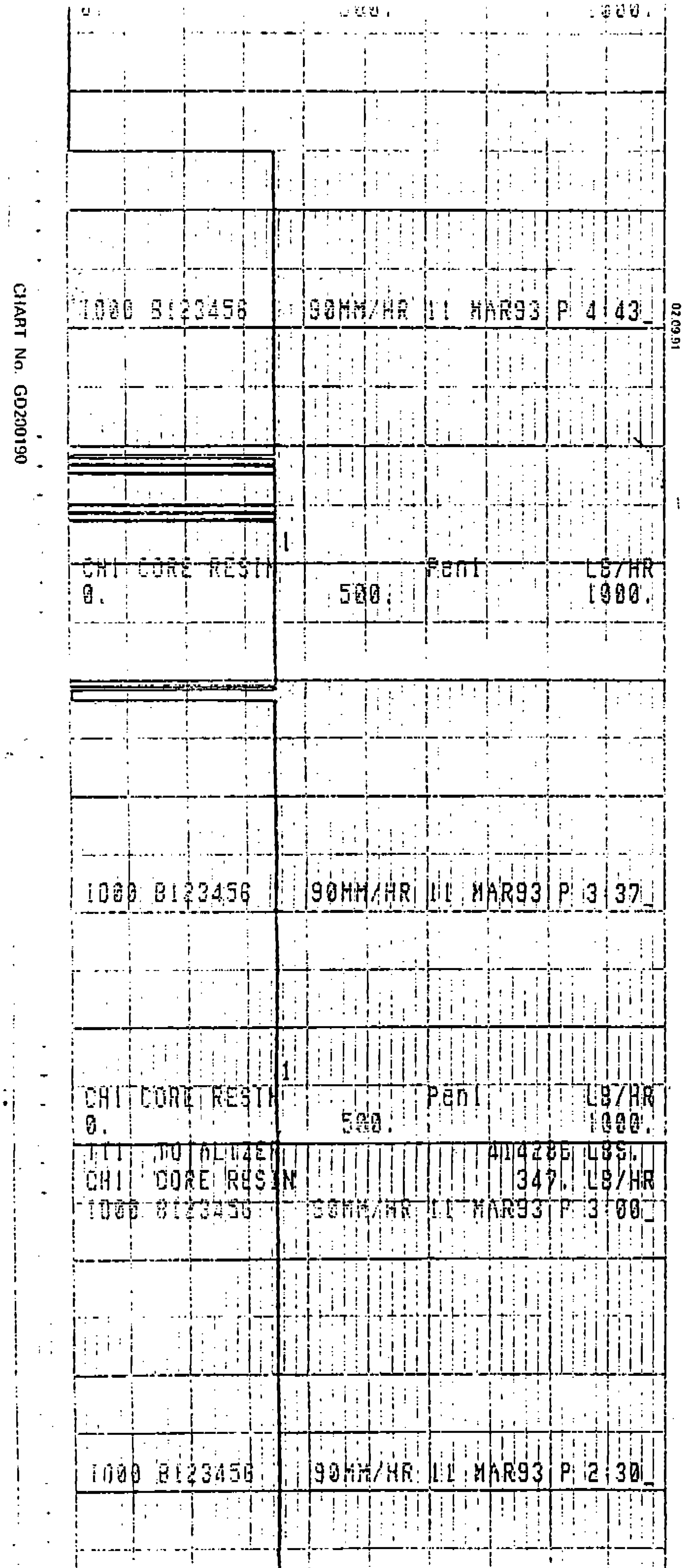

CHART No. GD200190
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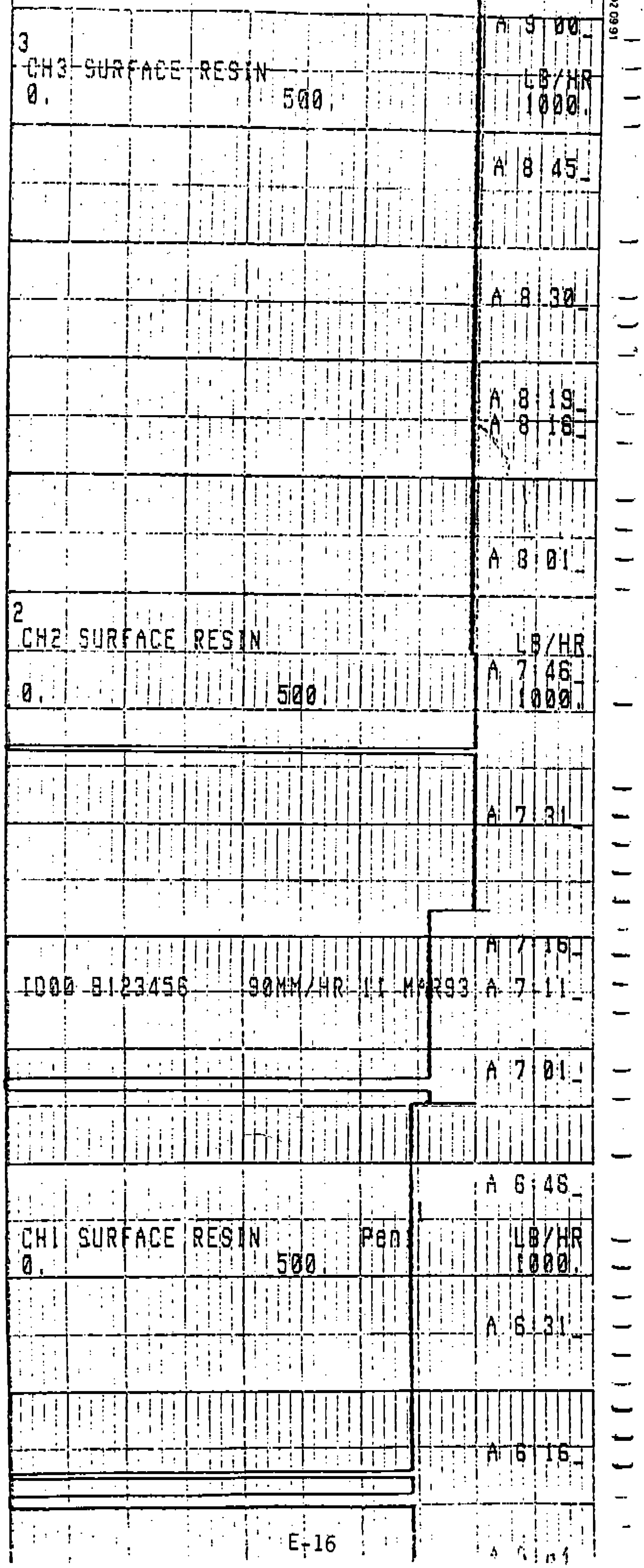
1
CH1 CORE RESIN Pen1 LB/HR
0. 500. 1000.
1000 B123456 90MM/HR 11 MAR93 P 3 37_
1
CH1 CORE RESIN Pen1 LB/HR
0. 500. 1000.
1T1 TOTALIZER A04286 LBS.
CH1 CORE RESIN 347. LB/HR
1000 B123456 90MM/HR 11 MAR93 P 3 00_
1000 B123456 90MM/HR 11 MAR93 P 2 30_

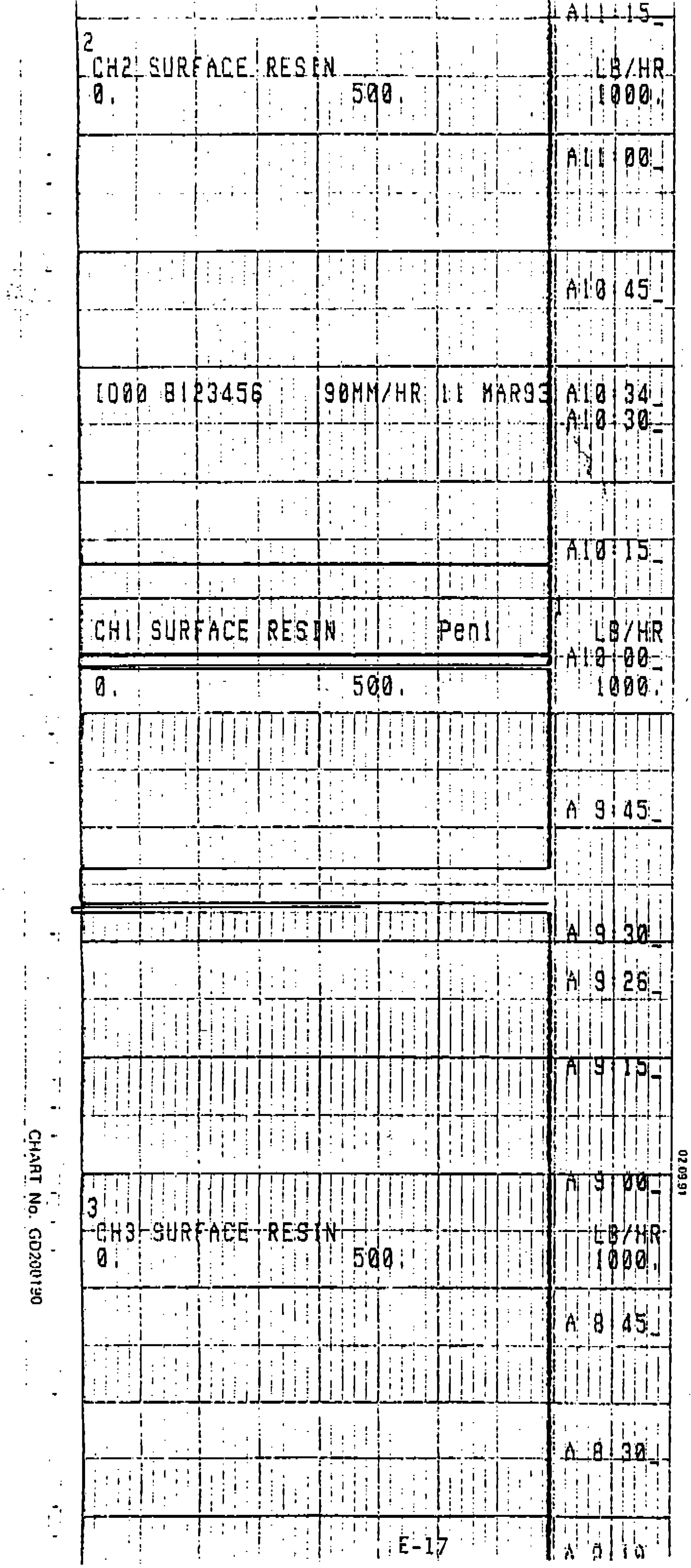
15

LIQUID
PHENOLIC



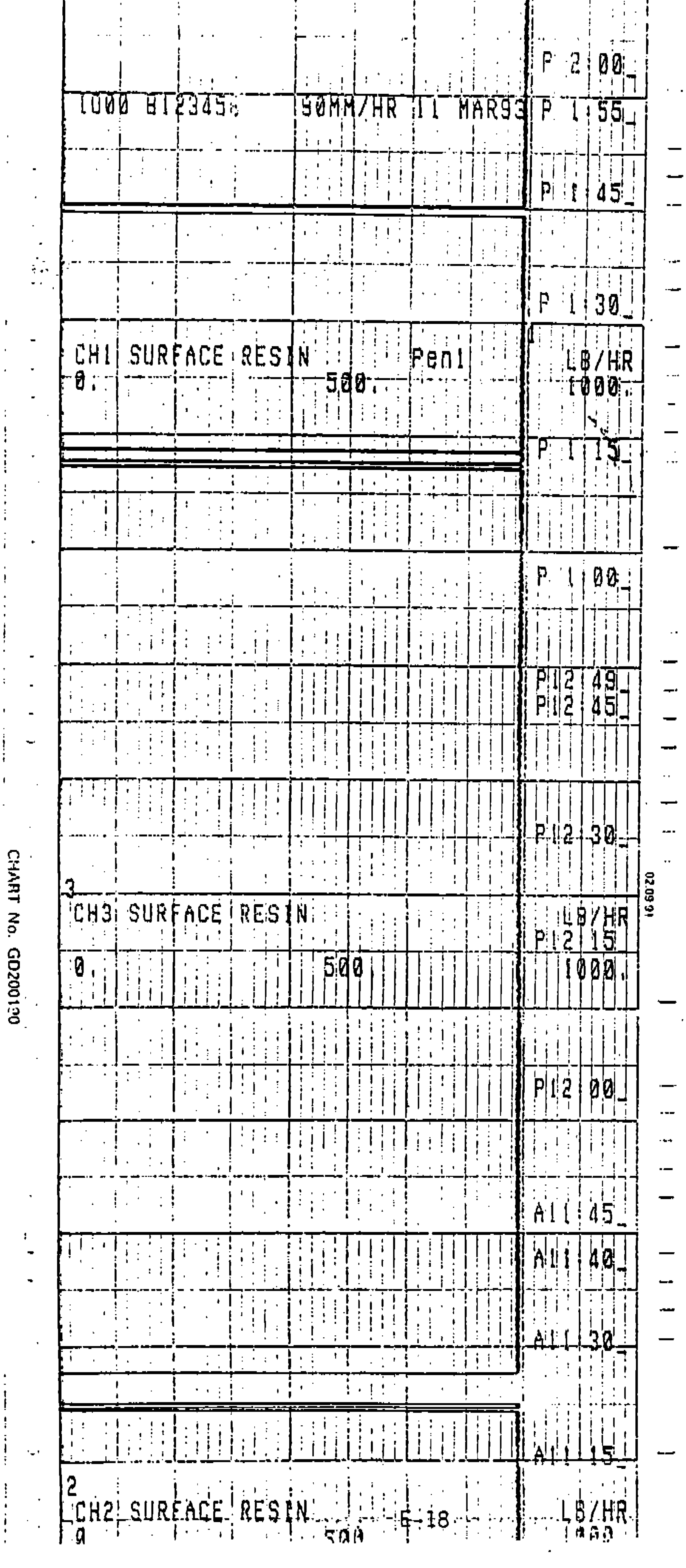
16

LIQUID
PHENOLIC



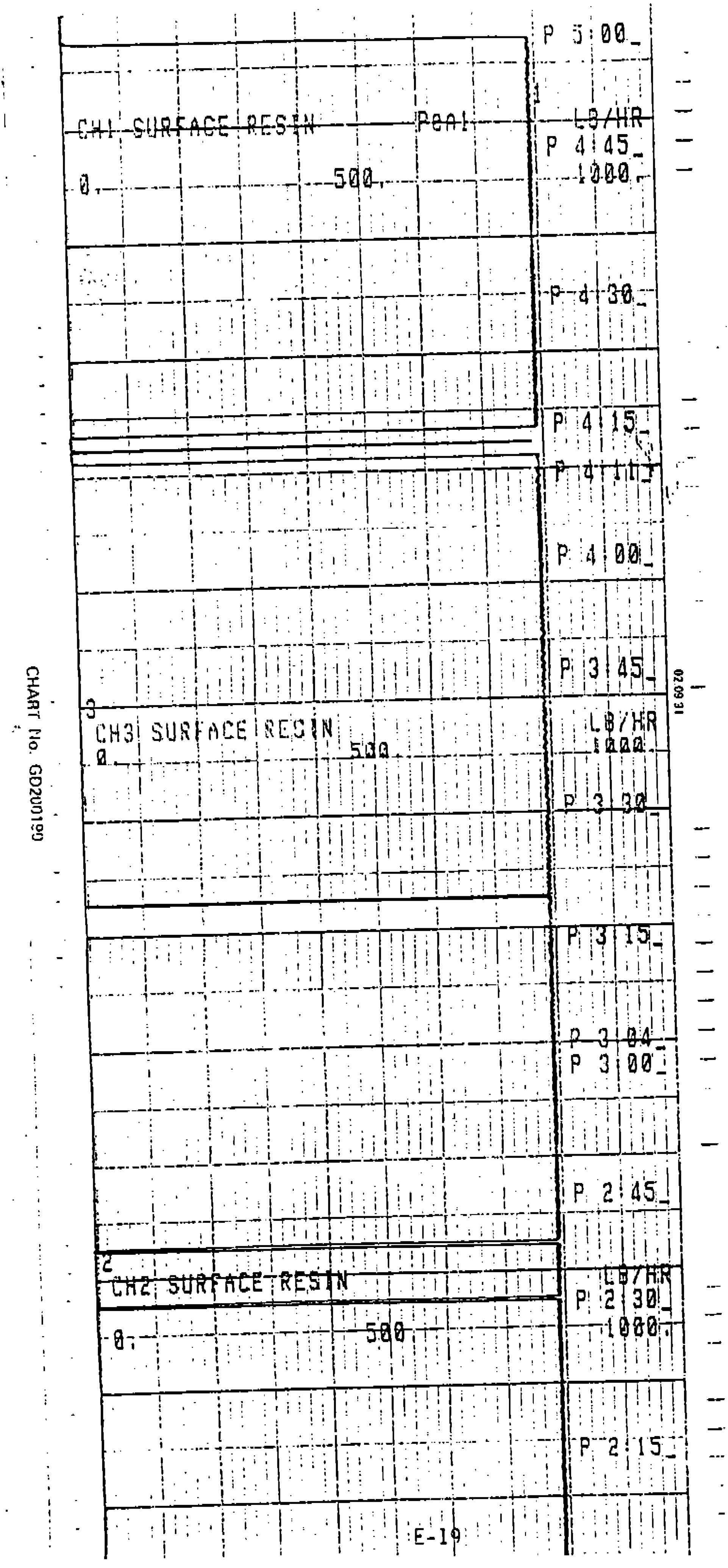
17

LIQUID PHENOLIC



18

LIQUID
PHENOLIC



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	WAX USE DAILY	WAX $ DAILY	WAX USE MTD	WAX $ MTD	WAX LBS IN INV
3-7	0	ERR	0		64734
3-8	0	ERR	0		64734
3-9	0	ERR	0		64734
3-10	3870	2.30	3870		60864
3-11	6774	2.36	10644		54090
		ERR	10644		
		ERR	10644		
		ERR	10644		
		ERR	10644		
		ERR	10644		
		ERR	10644		
		ERR	10644		
		ERR	10644		
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		ERR	10644		
		ERR	10644		
		ERR	10644		
		ERR	10644		

APPENDIX F

PROCEDURES

7/90

CONFIDENTIAL Version 1.1

Interpoll Laboratories
Method II-8791

Determination of 4,4'-Methylenebis (phenyl isocyanate)(MDI) in Wood Board Press Vent Exhausts

This method is a modification of NIOSH Method 347 in which a known volume of stack gas is drawn out of the stack through a glass-fiber filter impregnated with N-p-nitrobenzyl-N-propylamine to collect MDI. MDI reacts with this reagent to form a stable urea. The urea derivative is analyzed by HPLC. The modifications and the rationale therefor are enumerated below. The modifications used in this work were chosen expressly to accomodate the conditions normally encountered in board press exhaust gas stacks and may not be appropriate for other sources.

The method was modified by Interpoll Laboratories to 1) protect the urea derivative from exposure to high temperature; 2) to provide for isokinetic collection of samples, since some MDI will be associated with particles larger than 3 microns in diameter; 3) to make possible field recovery of samples, since stack testing requires repetitive determinations with large sophisticated sampling trains; 4) to increase the sensitivity of the determination; 5) and to more rigorously protect the collected samples since stack sampling normally requires transport of the samples by truck for extended periods of time.

The NIOSH was modified to meet the requirement of isokinetic collection by using a larger filter so that the same or a lower face velocity than that specified in the NIOSH Method is maintained, since the superficial face velocity is the controlling parameter in analyte breakthrough.

A non-heated probe liner and out-stack filter holder assembly will be used to sample the vents since the gas is essentially ambient air (100-110 °F) with very low moisture content. The filter holder will be of the "out-stack" type to minimize the effect of increased temperature on breakthrough. Sampling will be isokinetic to ensure representative collection of particles which may have MDI adsorbed on their surfaces.

Sample recovery will be quantitative using methylene chloride as the recovery solvent. Samples will be recovered into amber jars with Teflon lids and stored on ice or in a refrigerator until analysis. The filter and probe rinse will be recovered into the same container to initiate extraction immediately upon recovery in the field.

Criteria used in developing stack procedure:

1. The method as conceived for OSHA work uses a filter with an effective filtering area diameter of 1 cm. A flow rate of 1 LPM is recommended. At this superficial velocity, the collection efficiency for MDI was found to be >99.3%.

If $t_{amb} \leq 18\ ^{0}\mathrm{C}$ then $\emptyset \leq 10$ HRS

$18 \leq t_{amb} \leq 29\ ^{0}\mathrm{C}$ then $\emptyset \leq 5.5$ HRS

$29 \leq t_{amb} \leq 40\ ^{0}\mathrm{C}$ then $\emptyset \leq 3$ HRS

where $\emptyset$ = 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

Range: 4.4 to 800 $\mu g/m^3$
0.43 to 78 ppb

Matrix: Air

Precision: 0.078

Procedure: Collection and derivatization on impregnated filter, HPLC

$PPB = 0.0978(\mu g/m^3)$

Date Issued: 8/31/81

Date Revised:

Classification: E (Proposed)

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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 $\mu g/m^3$ during a 10-hour sampling period at 1 L/min when the air temperature is 18 °C.

2.3 It has been estimated that MDI at a concentration of 0.6 $\mu g/m^3$ could be detected in a 180-L air sample. The detection limit of MDIU in solution is equivalent to approximately 0.1 µg of MDI per mL if a 50-µL aliquot is injected into the HPLC.

3. Interferences

3.1 When other compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

3.2 _N_-_p_-Nitrobenzyl-_N_-propylamine on glass fiber filters is unstable in the presence of light and is unstable to a smaller degree during storage in the dark at room temperature. Interference during HPLC analysis may result if impregnated filters in filter holders are exposed to light for an excessive period or are stored in the dark at room temperature for an excessive period. Exposure of two impregnated filters inside filter holders to fluorescent lighting for 25 hours gave rise to interferences during HPLC analysis which corresponded to roughly 2 µg of MDI per filter. Storage of three impregnated filters for 41 days in the dark (33 days at room temperature and 8 days at -21 °C) gave rise to interferences which corresponded to an average of roughly 0.4 µg MDI per filter. Storage of six impregnated filters for 42 days in the dark at -21 °C gave rise to no interferences during HPLC analysis.

3.3 The following compounds would not interfere with the analysis of MDI in this method: toluene-2,4-diisocyanate (2,4-TDI), toluene-2,6-diisocyanate (2,6-TDI), and hexamethylene diisocyanate (HDI).

3.4 Any compound which has the same retention time as that of MDIU and is detected under the HPLC conditions indicated in this method is an interference.

4. Precision and Accuracy

4.1 The pooled relative standard deviation for the sampling and analytical method in the approximate range from 170 to 800 $\mu g/m^3$ 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.

11. References

11.1 Tucker, S. P., and J. E. Arnold, "Sampling and Analytical Methods for Toluene-2,4-diisocyanate and 4,4'-Methylenebis(phenyl isocyanate) in Air" (report in preparation).

11.2 Hastings Vogt, C. R., C. Y. Ko and T. R. Ryan, "Simple Ureas Derived from Diisocyantes and Their Liquid Chromatography on a 5-cm Column," J. Chromatogr., 134, 451-458 (1977).

11.3 Method No. P&CAM 142, "p,p- Diphenylmethane Diisocyanate (MDI) in Air," in NIOSH Manual of Analytical Methods, Vol. 1, Second Ed., D. G. Taylor, Ed., National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. DHEW (NIOSH) Publication No. 77-157-A.

Samuel P. Tucker, Ph.D.
James E. Arnold
Alexander W. Teass, Ph.D.
Organic Methods Development Section

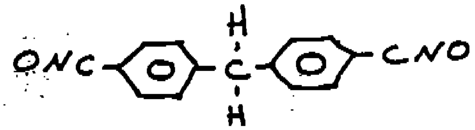
APPENDIX G

CALCULATION EQUATIONS

INTERPOLL LABORATORIES, INC

Concentration Calculation Equations for 4,4-Methylenebis (phenyl isocyanate) (MDI)

1. Structure:



2. Molecular weight:

250.27 g/g-mole

3. Mass/volume Concentration:

$$Cug/Nm3 = \frac{35.314\ m}{Vstd}$$

where m = Total mass of MDI in sample in micrograms (ug), and

Vstd = Total volume of exhaust gas or air sampled in dry standard cubic feet (DSCF).

4. Volume/volume Concentration:

$$Cppmv = \frac{\mu g}{Nm^3}\left[\frac{Nm^3}{1000 L} \times \frac{24.46 \mu L}{250.27 \mu g}\right]$$

$$Cppmv = 0.0978 \times 10^{-3}\ Cug/Nm3$$

5. Notes:

$$Cppbv = 0.0978 \frac{\mu g}{Nm^3}$$

Derived by: DJD/PL

Date: 1/15/93

Form S-511

CALCULATION OF MASS RATES

$$\dot{m}^{x} = \overset{\overset{C_s^{x}}{\downarrow}}{\frac{\text{mg}}{\text{Nm}^3}} \times \left(\frac{\text{g}}{10^3\,\text{mg}}\right) \times \left(\frac{\text{LB}}{453.6\,\text{g}}\right) \times \overset{\overset{Q_s}{\downarrow}}{\left(\frac{\text{DSCF}}{\text{MIN}}\right)} \times \left(\frac{1\,\text{Nm}^3}{35.31\,\text{DSCF}}\right) \times \left(\frac{60\,\text{M}}{1\,\text{HR}}\right.$$

$$\dot{m}^{x} = 3.746 \times 10^{-6}\, C_s Q_s$$

Where $\dot{m}$ = mass rate in LB/HR of Compound x

C_s = Concentration of Compound x in mg/Nm

Q_s = dry standard volumetric flow rate in DSCFM.

APPENDIX H

SAMPLING EQUIPMENT CALIBRATION DATA

INTERPOLL LABORATORIES
EPA Method 5 Gas Metering System
Quality Control Check Data Sheet

Date 3/1-93

Job 8324

Module No. 2

Operator M. Koehler

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 28.68 in. Hg. τ = 1.0004 ^H@ 1.79 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
	(339.50)		
2.5	341.40	39	39
5.0	343.29	40	39
7.5	345.18	41	39
10	347.08	43	39
	V_m= 7.58	Avg(t_m)= 39.875 °F	

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(1.0004)(7.58\ )}\left[\frac{(39.875) + 460}{(28.68)}\right]^{0.5}$$

Y_{cn} = .983

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: March 12, 1993

Meter Box No. : 2 (Rockwell Dry Test Meter Serial No. 964549)

Date of Last Calibration: February 5, 1993
Calibration Technician: D. Van Hoever
Wet Test Meter No.: American Meter AL-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
February 16, 1993	3-8186	756.60	1024.57	267.97	267.97
February 24, 1993	3-8237	1028.00	1338.93	310.93	578.90
March 11, 1993	3-8324	1339.50	1628.36	288.86	867.76

* Total volume through meter since last calibration.

INTERPOLL LABORATORIES, INC.
METER CALIBRATION SHEET
EPA METHOD 5

Date 2/5/93
Bar. Press. 29.36 in. Hg

Con[redacted]Mod[redacted]No. [redacted]
Serial No. DTM 964549
Wet Test Meter No. AL-20
Technician D. VAN Hoever

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)				
0.5	.5	2	99.85	0.01	742.06	744.12	68.4	88	76	5:00	.9931	1.74	
1.2	1.2	3	99.91	0.025	745.15	748.20	68.4	89	76	4:52	1.0058	1.76	
2.0	2.0	3	99.93	0.055	729.28	735.42	68.4	87	74	7:36	.9938	1.79	
3.3	3.3	5	100.00	0.09	736.45	741.54	68.4	90	75	4:58	1.0000	1.81	
4.7	4.7	5	100.02	0.12	748.70	754.25	68.4	92	77	4:38	1.0092	1.84	
											1.0004	1.79	
	2	3	4	5	6	7	8	9	10	11/13			

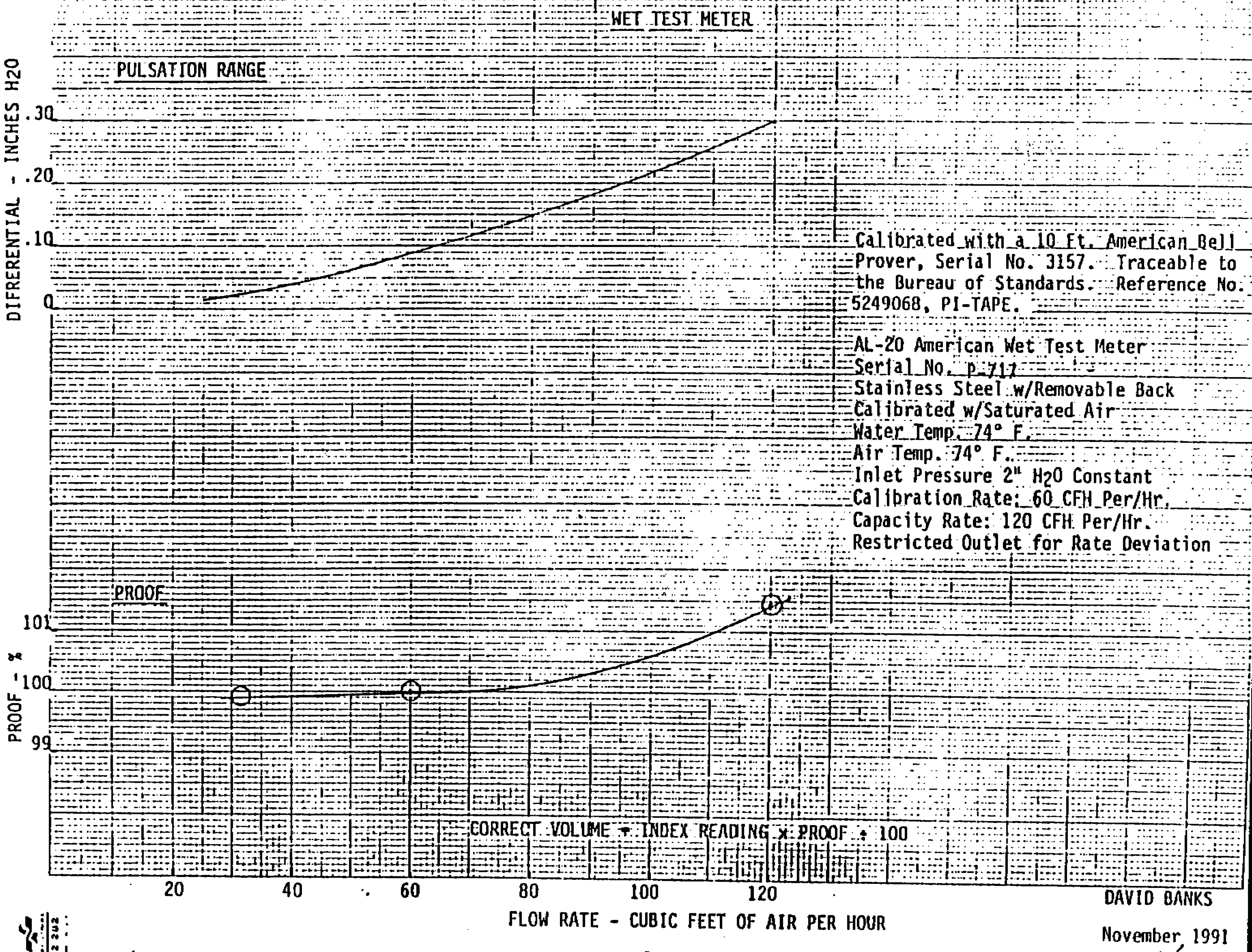
Positive leak check performed by
Meter was in tolerance ☒
Meter was not in tolerance ☐; readjusted linkage
Meter was not in tolerance ☐; changed dry test meters

Approved by Date 2/8/93

* Based on AL-20 wet test meter calibration in Nov. 1991 against Bell Prover (NBS Traceable) - Carl Poe

DIFFERENTIAL PRESSURE AND PROOF CALIBRATION CURVES

WET TEST METER



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

DAVID BANKS

November, 1991

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration:	3-11-93	Nozzle Number 8-3
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	.184
3	.184
Average:	.184

Interpoll Laboratories, Inc.

Temperature Measurement Device Calibration Sheet

Unit under test:
Vendor OMEGA
Model HH 21
Serial Number T-83080(PDT 25)
Range 0-2100 °F
Thermocouple Type K
Date of Calibration 1-8-93
Technician

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	3	.652
100	100	96	4	.714
200	200	199	1	.303
300	300	297	3	.395
400	400	396	4	.465
500	500	497	3	.313
600	600	598	2	.189
700	700	697	3	.259
800	800	799	1	.079
900	900	897	3	.221
1000	1000	998	2	.137
1100	1100	1097	3	.192
1200	1200	1199	1	.060
1300	1300	1297	3	.170
1400	1400	1399	1	.054
1500	1500	1497	3	.153
1600	1600	1598	2	.097
1700	1700	1695	5	.231
1800	1800	1797	3	.133
1900	1900	1895	5	.212
2000	2000	1996	4	.163
2100	2100	2094	6	.234
		Averages:	2.955	.247

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
(612)786-6020

Stack Sampling Department - QA
Aneroid Barometer Calibration Sheet

Date 2-8-93

Technician Mark Baehler

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})
29.40	73	.117	29.283	29.30	.017

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