

DU PONT CENTRAL RESEARCH AND DEVELOPMENT
HASKELL LABORATORY FOR TOXICOLOGY

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TECHNICAL FILE

C-1516

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TO: L. WOODS
CHEMICALS
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FROM: N. KRIVANEK *NK*

LEAD IN SOIL AND BLOOD LEAD LEVELS

The attached document shows the possible levels of lead in blood and the percentage of the population which would be below each particular level for lead in soil values of 100 to 500 ppm. These calculations are made with the EPA Biokinetic model, Lead 0.4, and were prepared by M.S. Bogdanffy at our laboratory.

From the table it can be seen that even at a lead in soil level of 500 $\mu\text{g/g}$ (500 ppm), about 95 percent of population would be below the 10 $\mu\text{g/dL}$ Pb Blood, the value EPA uses as a threshold for the most sensitive human population. At values of 250 ppm lead in soil, the current NJDEP clean-up value, and the proposed 100 ppm level, the percentage of the population below 10 $\mu\text{g/dL}$ are 99.81 and 100% respectively. We would conclude that adequate protection is offered at both values. Examination of the calculated geometric mean blood levels for 250 ppm and 100 ppm show values considerably below 10 $\mu\text{g/dL}$. The difference between blood leads for soil values of 250 and 100 ppm is small and for these calculations this difference is unlikely to be significant in terms of potential adverse health effects.

One could make an argument that adequate protection for the general population would be achieved when lead soil levels

would not contribute to raising blood lead values above the 10 $\mu\text{g/dL}$ for at least 95% of the most sensitive population. This would correspond to a 500 ppm lead in soil level for this model.

If you would like to discuss these issues in more detail, do not hesitate to contact me.

NK:ms

DU PONT CENTRAL RESEARCH AND DEVELOPMENT
HASKELL LABORATORY FOR TOXICOLOGY
AND INDUSTRIAL MEDICINE

cc: A. M. Kaplan
Central Files

March 25, 1992

To: Neil D. Krivanek, Ph.D.
Haskell Laboratory

From: Matthew S. Bogdanffy, Ph.D. *MSB*
Haskell Laboratory

IU-BK MODEL RESULTS FOR SOIL LEAD

The EPA Biokinetic model, LEAD 0.4 was used to relate soil lead levels to blood lead levels based on a series of potential soil lead concentrations ranging from 100 $\mu\text{g/g}$ to 500 $\mu\text{g/g}$. The program is only capable of modeling blood lead values of children up to age 7. Default assumptions of absorption methodology, concentrations of lead in air, diet, drinking water, paint, and maternal blood are were available within the model. These parameters can be modified if specific data are available.

The table below summarizes the geometric mean blood lead values of children up to age 7 for given soil lead concentrations. Also provided are percentages of the population whose blood lead would be above or below an arbitrary cut-off value of 10 $\mu\text{g/dL}$.

Soil Lead ($\mu\text{g/g}$)	Geometric Mean Blood Level ($\mu\text{g/dL}$)	Percentage Above 10 $\mu\text{g/dL}$	Percentage Below 10 $\mu\text{g/dL}$
100	2.38	0	100
150	2.80	0.01	99.99
200	3.23	0.06	99.94
250	3.65	0.19	99.81
300	4.00	0.48	99.52
500	5.78	0.52	94.48

*Geometric mean values are based on a population
geometric standard deviation of 1.42.

The default assumptions are listed below:

Absorption Methodology: Non-linear Active-Passive

Air Concentration: $0.200 \mu\text{g}/\text{m}^3$

Indoor Air Lead Concentration: 30% of outdoor

Other Air Parameters (see attachments)

Dietary Lead Intake:

Age	Dietary Lead Consumption ($\mu\text{g}/\text{day}$)
0-1	5.88
1-2	5.92
2-3	6.79
3-4	6.57
4-5	6.36
5-6	6.75
6-7	7.48

Drinking Water Concentration: $4.0 \mu\text{g}/\text{L}$

Water Consumption:

Age	Water Consumption (L/day)
0-1	0.2
1-2	0.5
2-3	0.52
3-4	0.53
4-5	0.55
5-6	0.58
6-7	0.59

Additional Dust Sources: None

Paint Intake: $0 \mu\text{g}$ lead/day

Maternal Contribution: Infant Model; maternal blood concentration = $7.50 \mu\text{g}/\text{dL}$

Age-specific blood lead, total lead uptake, and uptake of lead from soil+dust, diet, water, paint, and air are given in the attachments.

ABSORPTION METHODOLOGY: Non-Linear Active-Passive

AIR CONCENTRATION: 0.200 ug Pb/m3 DEFAULT

Indoor AIR Pb Conc: 30.0 percent of outdoor.

Other AIR Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

DIET: DEFAULT

DRINKING WATER Conc: 4.00 ug Pb/L

WATER Consumption: DEFAULT

SOIL & DUST:

Soil: constant conc.

Dust: constant conc.

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
0-1	100.0	100.0
1-2	100.0	100.0
2-3	100.0	100.0
3-4	100.0	100.0
4-5	100.0	100.0
5-6	100.0	100.0
6-7	100.0	100.0

Additional Dust Sources: None DEFAULT

PAINT Intake: 0.00 ug Pb/day DEFAULT

MATERNAL CONTRIBUTION: Infant Model

Maternal Blood Conc: 7.50 ug Pb/dL

CALCULATED BLOOD Pb and Pb UPTAKES:

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	2.44	6.38	3.00
1-2:	2.13	7.03	3.00
2-3:	2.12	7.56	3.00
3-4:	2.17	7.48	3.00
4-5:	2.23	7.41	3.00
5-6:	2.25	7.72	3.00
6-7:	2.30	8.11	3.00

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake (ug/day)
0.5-1:	2.94	0.40	0.00	0.04
1-2:	2.96	1.00	0.00	0.07
2-3:	3.39	1.04	0.00	0.12
3-4:	3.28	1.06	0.00	0.13
4-5:	3.18	1.10	0.00	0.13
5-6:	3.37	1.16	0.00	0.19
6-7:	3.74	1.18	0.00	0.19

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ABSORPTION METHODOLOGY: Non-Linear Active-Passive

AIR CONCENTRATION: 0.200 ug Pb/m3 DEFAULT

Indoor AIR Pb Conc: 30.0 percent of outdoor.

Other AIR Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

DIET: DEFAULT

DRINKING WATER Conc: 4.00 ug Pb/L

WATER Consumption: DEFAULT

SOIL & DUST:

Soil: constant conc.

Dust: constant conc.

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
0-1	150.0	150.0
1-2	150.0	150.0
2-3	150.0	150.0
3-4	150.0	150.0
4-5	150.0	150.0
5-6	150.0	150.0
6-7	150.0	150.0

Additional Dust Sources: None DEFAULT

PAINT Intake: 0.00 ug Pb/day DEFAULT

MATERNAL CONTRIBUTION: Infant Model

Maternal Blood Conc: 7.50 ug Pb/dL

CALCULATED BLOOD Pb and Pb UPTAKES:

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	2.87	7.88	4.50
1-2:	2.57	8.53	4.50
2-3:	2.55	9.06	4.50
3-4:	2.60	8.98	4.50
4-5:	2.68	8.91	4.50
5-6:	2.70	9.22	4.50
6-7:	2.74	9.61	4.50

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake (ug/day)	6
0.5-1:	2.94	0.40	0.00	0.04	
1-2:	2.96	1.00	0.00	0.07	
2-3:	3.39	1.04	0.00	0.12	
3-4:	3.28	1.06	0.00	0.13	
4-5:	3.18	1.10	0.00	0.13	
5-6:	3.37	1.16	0.00	0.19	
6-7:	3.74	1.18	0.00	0.19	

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ABSORPTION METHODOLOGY: Non-Linear Active-Passive

AIR CONCENTRATION: 0.200 ug Pb/m3 DEFAULT

Indoor AIR Pb Conc: 30.0 percent of outdoor.

Other AIR Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

DIET: DEFAULT

DRINKING WATER Conc: 4.00 ug Pb/L

WATER Consumption: DEFAULT

SOIL & DUST:

Soil: constant conc.
Dust: constant conc.

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
0-1	200.0	200.0
1-2	200.0	200.0
2-3	200.0	200.0
3-4	200.0	200.0
4-5	200.0	200.0
5-6	200.0	200.0
6-7	200.0	200.0

Additional Dust Sources: None DEFAULT

PAINT Intake: 0.00 ug Pb/day DEFAULT

MATERNAL CONTRIBUTION: Infant Model

Maternal Blood Conc: 7.50 ug Pb/dL

CALCULATED BLOOD Pb and Pb UPTAKES:

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	3.30	9.38	6.00
1-2:	3.01	10.03	6.00
2-3:	2.98	10.56	6.00
3-4:	3.04	10.48	6.00
4-5:	3.12	10.41	6.00
5-6:	3.15	10.72	6.00
6-7:	3.18	11.10	6.00

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YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake (ug/day)	8
0.5-1:	2.94	0.40	0.00	0.04	
1-2:	2.96	1.00	0.00	0.07	
2-3:	3.39	1.04	0.00	0.12	
3-4:	3.28	1.06	0.00	0.13	
4-5:	3.18	1.10	0.00	0.13	
5-6:	3.37	1.16	0.00	0.19	
6-7:	3.74	1.18	0.00	0.19	

ABSORPTION METHODOLOGY: Non-Linear Active-Passive

AIR CONCENTRATION: 0.200 ug Pb/m3 DEFAULT

Indoor AIR Pb Conc: 30.0 percent of outdoor.

Other AIR Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

DIET: DEFAULT

DRINKING WATER Conc: 4.00 ug Pb/L

WATER Consumption: DEFAULT

SOIL & DUST:

Soil: constant conc.

Dust: constant conc.

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
0-1	250.0	250.0
1-2	250.0	250.0
2-3	250.0	250.0
3-4	250.0	250.0
4-5	250.0	250.0
5-6	250.0	250.0
6-7	250.0	250.0

Additional Dust Sources: None DEFAULT

PAINT Intake: 0.00 ug Pb/day DEFAULT

MATERNAL CONTRIBUTION: Infant Model

Maternal Blood Conc: 7.50 ug Pb/dL

CALCULATED BLOOD Pb and Pb UPTAKES:

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	3.73	10.88	7.50
1-2:	3.45	11.53	7.50
2-3:	3.41	12.06	7.50
3-4:	3.47	11.98	7.50
4-5:	3.57	11.91	7.50
5-6:	3.59	12.22	7.50
6-7:	3.62	12.60	7.50

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake /0 (ug/day)
0.5-1:	2.94	0.40	0.00	0.04
1-2:	2.96	1.00	0.00	0.07
2-3:	3.39	1.04	0.00	0.12
3-4:	3.28	1.06	0.00	0.13
4-5:	3.18	1.10	0.00	0.13
5-6:	3.37	1.16	0.00	0.19
6-7:	3.74	1.18	0.00	0.19

ABSORPTION METHODOLOGY: Non-Linear Active-Passive

AIR CONCENTRATION: 0.200 ug Pb/m3 DEFAULT

Indoor AIR Pb Conc: 30.0 percent of outdoor.

Other AIR Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

DIET: DEFAULT

DRINKING WATER Conc: 4.00 ug Pb/L

WATER Consumption: DEFAULT

SOIL & DUST:

Soil: constant conc.

Dust: constant conc.

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
0-1	300.0	300.0
1-2	300.0	300.0
2-3	300.0	300.0
3-4	300.0	300.0
4-5	300.0	300.0
5-6	300.0	300.0
6-7	300.0	300.0

Additional Dust Sources: None DEFAULT

PAINT Intake: 0.00 ug Pb/day DEFAULT

MATERNAL CONTRIBUTION: Infant Model

Maternal Blood Conc: 7.50 ug Pb/dL

CALCULATED BLOOD Pb and Pb UPTAKES:

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	4.17	12.38	9.00
1-2:	3.89	13.03	9.00
2-3:	3.85	13.56	9.00
3-4:	3.90	13.48	9.00
4-5:	4.02	13.41	9.00
5-6:	4.04	13.72	9.00
6-7:	4.06	14.10	8.99

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake /2 (ug/day)
0.5-1:	2.94	0.40	0.00	0.04
1-2:	2.96	1.00	0.00	0.07
2-3:	3.39	1.04	0.00	0.12
3-4:	3.28	1.06	0.00	0.13
4-5:	3.18	1.10	0.00	0.13
5-6:	3.37	1.16	0.00	0.19
6-7:	3.74	1.18	0.00	0.19

ABSORPTION METHODOLOGY: Non-Linear Active-Passive

AIR CONCENTRATION: 0.200 ug Pb/m3 DEFAULT

Indoor AIR Pb Conc: 30.0 percent of outdoor.

Other AIR Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

DIET: DEFAULT

DRINKING WATER Conc: 4.00 ug Pb/L

WATER Consumption: DEFAULT

SOIL & DUST:

Soil: constant conc.
Dust: constant conc.

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
0-1	500.0	500.0
1-2	500.0	500.0
2-3	500.0	500.0
3-4	500.0	500.0
4-5	500.0	500.0
5-6	500.0	500.0
6-7	500.0	500.0

Additional Dust Sources: None DEFAULT

PAINT Intake: 0.00 ug Pb/day DEFAULT

MATERNAL CONTRIBUTION: Infant Model

Maternal Blood Conc: 7.50 ug Pb/dL

CALCULATED BLOOD Pb and Pb UPTAKES:

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	5.90	18.38	15.00
1-2:	5.66	19.02	14.99
2-3:	5.57	19.55	14.99
3-4:	5.64	19.46	14.98
4-5:	5.81	19.39	14.97
5-6:	5.82	19.69	14.96
6-7:	5.82	20.06	14.95

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake ¹⁴ (ug/day)
0.5-1:	2.94	0.40	0.00	0.04
1-2:	2.96	1.00	0.00	0.07
2-3:	3.39	1.04	0.00	0.12
3-4:	3.28	1.06	0.00	0.13
4-5:	3.18	1.10	0.00	0.13
5-6:	3.37	1.16	0.00	0.19
6-7:	3.74	1.18	0.00	0.19