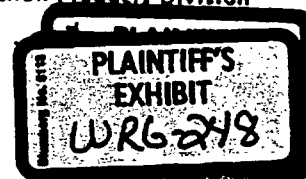


GRACE

Construction Products Division



To: R. M. Vining

Date: August 16, 1977

From: R. H. Locke

Subject: CPSC Risk
Assessment

cc: W. F. McCord
E. S. Wood

00156097

As you requested, please see the attached CPSC Risk Assessment turned to paperclipped Table 1 which I have marked up per our discussion. We were talking about CPSC estimated cancer death rates between 10 and 1,000 per million. They are derived from the table;

- I. A. 8 hr. TWA in use of joint compounds assumed: 20 f/ml
B. 1 Year Equivalent Exposure @ 4 das./200 day year: 0.4 f/ml
C. Enter Table @ 0.5 f/ml (approx. 0.4 f/ml) and read 13 deaths (approx. 10) per million
- II. A. 5 Years of heavy exposure @ 0.4 f/ml annual equivalent calculated as being same as 1 year at 2.0 f/ml
B. Enter Table @ 2.0 f/ml and read 990 deaths (approx. 1,000) per million
- III. A. If the 1 Year Equivalent Exposure were 0.1 f/ml,
B. (This is same as 5 f/ml 8 hr. TWA for 4 days or 20 f/ml 8 hr. TWA for 1 day)
C. Enter Table @ 0.1 f/ml and read 0.02 deaths per million and relative risk of 1.0000006.
- IV. A. If the 1 Year Equivalent Exposure were 0.01 f/ml,
B. (This is same as 0.5 f/ml 8 hr. TWA for 4 days or 2.0 f/ml for 1 day)
C. Cols. (4), (5), and (6) can't be calculated from standard integral Tables (one attached and paperclipped). Cols. (1), (2), and (3) are shown, however.

In closing, let's again note that this CPSC model employs a multiplicative combination of several adverse assumptions.

R. H. Locke
R. H. Locke
y

RHL/cf

Memorandum

TO : Don Clay, Acting AED for Engineering & Sciences DATE: June 3, 1977
THRU : Robert M. Behir, Actg. Deputy AED for Health Sciences *RMH:ajf*
FROM : Steven Bayard, Ph.D./SPSC *Steven Bayard*
SUBJECT: Risk of Respiratory Cancer Due to Low Level Exposure to Asbestos from
Spackling & Joint Taping Compounds

Summary & Discussion

A model for lifetime risk assessment of death from respiratory cancer due to consumer use of asbestos containing wall taping compounds is presented. Based on heavy exposure four times a year for 1 year, increased risk of death from respiratory cancer is estimated at 10 per million. For five years of exposure at these levels, however, the risk increases geometrically and is estimated at 1,000 per million or 1 per thousand.

06166098

For consumers using ready mixed spackling compounds to fill a few small holes and doing a little sanding, the model predicts negligible risk.

No quantitative risk assessment was made for asbestos exposure from the artificial ash adorning the emberized gas logs since there are no known measurements of the airborne fiber content. It can be assumed, however, that whatever air concentrations are present, they expose the home occupant to a repository of free fibers continuously vs. only intermittent exposure for the wall taping compounds. The risk from these ashes, therefore, may be considered at least as high as that from the wall taping compounds.

A. Assumptions

In order to compute a risk assessment of the use of asbestos containing wall joint compounds, many assumptions had to be made. The model used is mainly that of Enterline and Henderson (1976), which in turn was derived from data on amosite asbestos factory workers and asbestos insulation workers (Selikoff, Hammond and Seidman, 1973). Measurements of asbestos fibers longer than 5 microns from work with wall taping compounds were taken by Rohl et al (1975). Projections of consumer use of taping compounds are my own and age central death rates from respiratory cancer were based on the 1970-71 vital statistics of the United States.

The assumptions used in the risk assessment model are presented below; references for each are given.

1. The dose-response relationship between asbestos and lung cancer is linear (Enterline and Henderson, 1976; McDonald, et al, 1974). This hypothesis assumes no threshold.

2. Time to tumor is dependent on dose and can be described by a log normal distribution with median time to tumor t :

$$t = 98.65 \left(\frac{1}{D} \right)^{1/3}$$

where D = 8-hour time weighted average dose in fibers/cc and a standard deviation of 1.5 f/cc. (Enterline and Henderson, 1976, based on Jones and Grindon, 1975).

3. Competing risks of death for the first 40 years following exposure are considered to be normal.

4. Risk of asbestos caused death after the first 40 years following exposure is considered to be zero.

5. Effect of dose is cumulative and is assumed to have the same effect as if that dose had been accumulated in the first year of exposure.

6. Intermittent exposure with occasional high peaks has the same cumulative effect as continuous exposure at double the dose (Enterline, et al, 1972; Nicholson, 1976).

06160099

While assumptions 1-5 may seem a bit unclear, the total effect is to present a cumulative dose-response curve of the form log dose-log response. This is shown in Figure 1. Explanation of how these figures were derived is given below. It is emphasized, however, that this model is to be used for low exposure estimates. It does not fit the data for high or long term exposure data.

B. Derivation of Total Cases Caused by Asbestos Exposure

Besides the assumptions 1-6 above, the major data used to estimate the total cancer deaths attributable to dose were the Selikoff data on 294 factory workers who had been exposed to asbestos for 3-11 months during the years 1941-1945. Estimates of the concentration of asbestos dust during this period averaged 30 f/cc. Since the average exposure was only 5/8 year, the equivalent concentration was figured at 18.75 f/cc/day on a 1 year basis. By assumption 2, the median time to death from respiratory cancer is 37.1 years. Also, by assumption 2, the log normal distribution shows that for the 28 years of followup used in the Selikoff paper only 24.4% of these deaths would have occurred. Since the adjusted relative risk of these workers was 2.95 (Enterline, 1976), and the age central death rate from respiratory cancer (ages 35+) was 350/million, the number of respiratory deaths which could have been caused by the asbestos exposure was the solution to

$$\frac{28(.000850) + .244 X}{28 (.000850)} = 2.95$$

or $X = .190205$ or 190,205 deaths/million. But, since only 40 years of exposure are considered (assumptions 3 and 4), assumption 2 allows only 57.3% or 109,000 lifetime cancer respiratory deaths per million exposed.

By assumption 1, the number of potential cases by dose can then be calculated and risk estimates can be derived from these. This is shown in Table 1, along with the calculated relative risks. Here it is seen that excess deaths and relative risks do not increase linearly with increasing dose but in a geometric manner. 06166100

C. Estimates of Exposure Levels of Consumer Users of Wall Taping Compounds

Rohl (1975) measured peak fiber concentrations of ten drywall taping compounds during sanding, dry mixing, and floor sweeping. The average peaks were as high as 47 f/cc with the highest individual peak of 59 f/cc. Based on these peaks the 8-hour time weighted average was estimated as 10 f/cc. Taken with assumption 6 that high intermittent exposure was estimated to have doubled the effect of continuous exposure, this estimate was increased to 20 f/cc. If there are four uses projected per year, the estimate of yearly equivalent is

$$\frac{20 \text{ f/cc/day} \times 4 \text{ days}}{200 \text{ days/year}} = .4 \text{ f/cc/day for 1 year}$$

FIGURE 1. Response vs. Dose for Low Level Asbestos

Exposure. Asbestos Induced Respiratory Cancer Deaths per Million
Lifetime vs. Daily Exposure (f/cc) for 1 Year.
Estimates Based on the Model

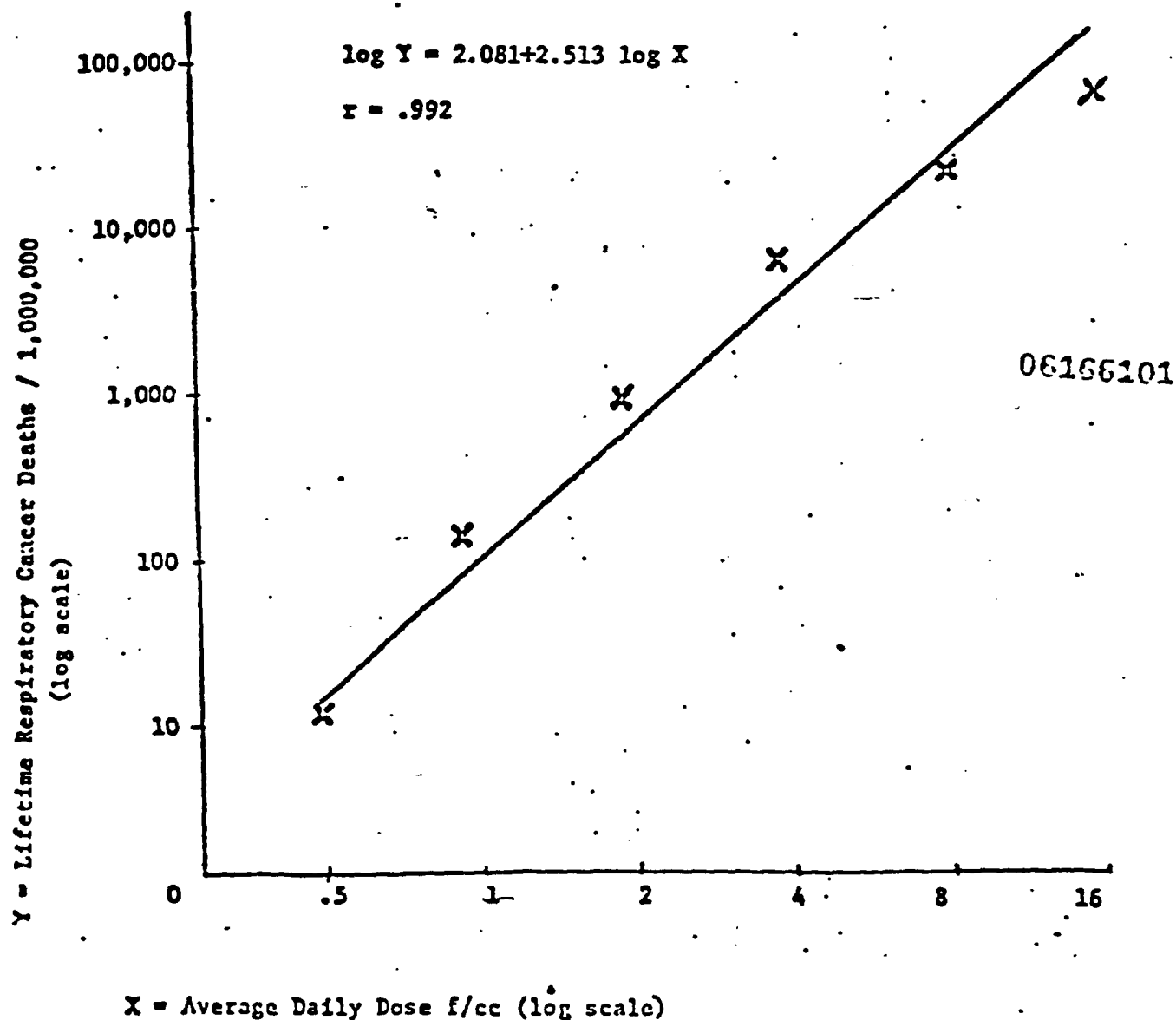


TABLE 1. Lifetime (40 Year) Risk Estimates of Respiratory Cancer Deaths by Dose for a 1 Year Equivalent Exposure. Median Latent Periods and Relative Risks are Included.

00160102

(1)	(2)	(3)	(4)*	(5)	(6)
"D"	"t"	p3p*			
8-Hour Avg. Daily Exposure Level-D f/cc (Given)	Latent Periods Years $t = 98.65 \left(\frac{1}{D}\right)^{1/3}$ Solve for "t" @ each "D"	Potential Cases/ Million (see text) Proportional from 190,205 @ lower "D"	Proportion Developed in 40 Years (log normal)	Asbestos Induced Respir. Cancer Deaths/ (3)x(4)	Relative Risk $\frac{(3)+850 \times 40}{850 \times 40}$
.001	486.5	10	—	—	—
.01	457.5	101	—	—	—
.1	212.5	1014	.0000189	2092	1.0000006
.5	124.3	5,072	.0026	13	1.00038
1	98.6	10,145	.0130	132	1.00388
2	78.3	20,290	.0488	990	1.02912
4	62.1	40,578	.1488	6,038	1.17759
8	49.3	81,155	.3030	24,590	1.72324
16	39.1	162,310	.4776	77,519	3.27997
18.75	37.1	190,205	.5727	109,000	4.20588

* Solve: $\frac{\log 40 - \log "t"}{\log 1.5}$ and interpolate solution in

a Normal Probability Integral Table (one attached).
For example, @ a "D" of 0.5 f/ml, solution is -2.18
& attached marked up table gives you 0.002551, or
col. (4) above rounded to 0.0026 x @ "D" of 0.1 f/ml.
Solution is -4.12 & table gives you 0.0000189 x

Thus, based on the results of the model, Table 1, those four uses in 1 year with heavy exposure will cause an additional 10 lifetime respiratory cancer deaths/million. Continued use for five years will, by assumption 5, raise that estimate to 990 (see Table 1) deaths per million.

06166103

REFERENCES

Enterline, P.E.; DeCoufle, P.; Henderson, V: Mortality in relation to occupational exposure in the asbestos industry. JOM, Vol. 14, No. 12 pp. 897-903. December 1972

Enterline, P.; Henderson, V.: A Model for Extrapolating to Low Levels of Asbestos Exposure. Presented at Conference on Problems of Extrapolating the Results of Laboratory Animal Data to Men and Extrapolating the Results from High Dose Level Experiments to Low Dose Level Exposure, Pinehurst, N.C., March 11, 1976.

Jones, H.B.; Grindon, A.: Environmental factors in the origin of cancer and estimation of the possible hazard to man. Fd. Cosmet. Toxicol. 18:251-268, 1975.

McDonald, J.C.; McDonald, A.D.; Gibbs, G.W., et al: The health of chrysotile asbestos mine and mill workers of Quebec. Arch. Environ. Health 28:61, 1974.

06166104

Nicholson, W.J.: Case Study 1: Asbestos--The TLV Approach. Occupational Carcinogenesis, Annals of the New York Academy of Sciences, Vol. 271:152-169, May 1976.

Rohl, A.N., et al: Exposure to Asbestos in the Use of Consumer Spackling, Patching and Taping Compounds. Science, Vol. 189: 551-553, 8/15/75

Selikoff, I.J.; Hammond, E.C.; Seidman, H: Cancer risk of insulation workers in the United States. IARC, Biological Effects of Asbestos, Lyon, France, 1973.

STATISTICAL TABLES

FOR BIOLOGICAL, AGRICULTURAL
AND MEDICAL RESEARCH

BY

SIR RONALD A. FISHER, Sc.D., F.R.S.

FORMERLY ARTHUR BALFOUR PROFESSOR OF GENETICS, UNIVERSITY OF
CAMBRIDGE, AND GALTON PROFESSOR, UNIVERSITY OF LONDON. HONORARY
MEMBER, AMERICAN STATISTICAL ASSOCIATION AND AMERICAN ACADEMY
OF ARTS AND SCIENCES. FOREIGN MEMBER OF THE AMERICAN PHILO-
SOPHICAL SOCIETY. FOREIGN ASSOCIATE OF THE NATIONAL ACADEMY
OF SCIENCES OF THE UNITED STATES OF AMERICA. FOREIGN MEMBER OF
THE ROYAL SWEDISH ACADEMY OF SCIENCES AND THE ROYAL DANISH
ACADEMY OF SCIENCES AND LETTERS. MEMBER OF THE PONTIFICAL
ACADEMY OF SCIENCES

AND

FRANK YATES, C.B.E., Sc.D., F.R.S.

HEAD OF STATISTICAL DEPARTMENT, ROTHAMSTED
EXPERIMENTAL STATION, AND OF THE RESEARCH STATISTICAL
SERVICE OF THE AGRICULTURAL RESEARCH COUNCIL
AND THE MINISTRY OF AGRICULTURE

SIXTH EDITION
REVISED AND ENLARGED



HAFNER PUBLISHING COMPANY INC.
NEW YORK

06166105

TABLE III. THE NORMAL PROBABILITY INTEGRAL

z	0	1	2	3	4	5	6	7	8	9
0.0	50000	49601	49202	48803	48405	48006	47608	47210	46812	46414
0.1	46017	45620	45224	44828	44433	44038	43644	43251	42858	42465
0.2	42074	41683	41294	40905	40517	40129	39743	39358	38974	38591
0.3	38209	37828	37448	37070	36693	36317	35942	35569	35197	34827
0.4	34458	34090	33724	33360	32997	32636	32276	31918	31561	31207
0.5	30854	30503	30153	29806	29460	29116	28774	28434	28096	27760
0.6	27425	27093	26763	26435	26109	25785	25463	25143	24825	24510
0.7	24196	23885	23576	23270	22965	22663	22363	22065	21770	21476
0.8	21186	20897	20611	20327	20045	19766	19489	19215	18943	18673
0.9	18406	18141	17879	17619	17361	17106	16853	16602	16354	16109
1.0	15866	15625	15386	15151	14917	14686	14457	14231	14007	13786
1.1	13567	13350	13136	12924	12714	12507	12302	12100	11900	11702
1.2	11507	11314	11123	10935	10749	10565	10383	10204	10027	98525
1.3	96800	95098	93418	91759	90123	88508	86915	85343	83793	82264
1.4	80757	79270	77804	76359	74934	73529	72145	70781	69437	68112
1.5	66807	65522	64255	63008	61780	60571	59380	58208	57053	55917
1.6	54799	53699	52616	51551	50503	49471	48457	47460	46479	45514
1.7	44565	43633	42716	41815	40930	40059	39204	38364	37538	36727
1.8	35930	35148	34380	33625	32884	32157	31443	30742	30054	29379
1.9	28717	28067	27429	26803	26190	25588	24998	24419	23852	23295
2.0	22750	22216	21692	21178	20675	20182	19699	19226	18763	18309
2.1	17864	17429	17003	16586	16177	15778	15386	15003	14629	14262
2.2	13903	13553	13209	12874	12545	12224	11911	11604	11304	11011
2.3	10724	10444	10170	99031	96419	93867	91375	88940	86563	84242
2.4	81975	79763	77603	75494	73436	71428	69469	67557	65691	63872
2.5	62097	60366	58677	57031	55426	53861	52336	50849	49400	47988
2.6	46612	45271	43965	42692	41453	40246	39070	37926	36811	35726
2.7	34670	33642	32641	31667	30720	29798	28901	28028	27179	26354
2.8	22551	21771	21012	20274	19557	18860	18182	17524	16884	16262
2.9	18658	18071	17502	16948	16411	15889	15382	14890	14412	13949
3.0	13499	13062	12639	12228	11829	11442	11067	10703	10350	10008
3.1	96760	93544	90426	87403	84474	81635	78885	76219	73638	71136
3.2	68714	66367	64095	61895	59765	57703	55706	53774	51904	50094
3.3	48342	46648	45009	43423	41889	40406	38971	37584	36243	34946
3.4	33693	32481	31311	30179	29086	28029	27009	26023	25071	24151
3.5	23263	22405	21577	20778	20006	19262	18543	17849	17180	16534
3.6	15911	15310	14730	14171	13632	13112	12611	12128	11662	11213
3.7	10780	10363	99611	95740	92010	88417	84957	81624	78414	75324
3.8	72348	69483	66726	64072	61517	59059	56694	54418	52228	50122
3.9	48096	46148	44274	42473	40741	39076	37475	35936	34458	33037
4.0	31671	30359	29099	27888	26726	25609	24536	23507	22518	21569
4.1	20658	19781	18944	18138	17365	16624	15912	15230	14575	13948
4.2	13346	12769	12215	11685	11176	10689	10221	97736	93447	89337
4.3	85399	81627	78015	74555	71241	68069	65031	62123	59340	56675
4.4	54125	51685	49350	47117	44979	42935	40980	39110	37322	35612
4.5	33977	32414	30920	29492	28127	26823	25577	24386	23249	22162
4.6	22125	20133	19187	18283	17420	16597	15810	15060	14344	13660
4.7	13008	12386	11792	11226	10686	10171	96796	92113	87648	83391
4.8	79333	75465	71779	68267	64920	61731	58693	55799	53043	50418
4.9	47918	45538	43272	41115	39061	37107	35247	33476	31792	30190

00166106