FROM J. V. HOLDER

PITTSBURGH OFFICE - 20 AB

TO R. M. JAMES

PITTSBURGH OFFICE - 6 AB

1988 SEPTEMBER 01

RE: RECORD RETENTION - ASBESTOS REMOVAL/DEMOLITION

Any closed contract involving the removal of asbestos will be kept with the Procurement Department records at the Records Storage Center at Boyers, PA. The contract shall be identified with a notation that after the retention period of thirty (30) years, specific approval must be obtained from the Procurement Department prior to the destruction of the records.

All contracts involving the removal of asbestos are normally written by the Pittsburgh Procurement Department. However, by copy of this letter, all of our plants including subsidiaries are being notified that if they do write any such contracts, they must make arrangements for the extended record storage period.

J. V. HOLDER

JVH/mk

cc: Domestic Location & Subsidiary Procurement Mgrs. (PDA 3&4)
P. R. Atkins - Pgh/19 AB
~~H. D. Belk - Pgh/6 AB~~
W. K. Benefield - Pgh/20 AB
R. F. Burnos - Pgh/8 AB
C. L. Carleo - Pgh/20 AB
A. L. Doner - Pgh/20 AB
G. R. Farneth - Pgh/20 AB
H. M. Goern - Pgh/29 AB
M. W. Leeper - Pgh/20 AB
T. G. Pollak - Pgh/20 AB
R. G. Quaintance - Pgh/20 AB
L. L. Rippey - Pgh/6 AB
L. M. Schneider - Pgh/6 AB
R. E. Yester - Pgh/20 AB
J. R. Zokaites - Pgh/20 AB

PLAINTIFF'S EXHIBIT AL-1424

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ALCOA

SF-4563 (REV 85-7)

1H. NEWSLETTERS DEALING WITH ASBESTOS

5/4/64 MARINITE CONTAINS ASBESTOS

12/23/71 EMERGENCY STANDARD FOR ASBESTOS

Need to control exposures. Copy of proposal enclosed

4/17/72 ASBESTOS DUST EXPOSURES (Proposed Final Standard enclosed)

a) Identification of sources in our plants

b) Plants advised to make inventory

c) Evaluate exposures

d) change work practices

e) monitor exposures

methods + instrumentation outlined (A completely new method of evaluation)

7/1/72 OSHA ASBESTOS STANDARD (Effective date of Std, 7/7/72)

a) highlight standards content

b) copy of std enclosed

7/20/72 APPROVED ASBESTOS RESPIRATORY PROTECTION (Recomendations Provided)

8/21/72 ASBESTOS-CONTAINING REFRACTORY + INSULATING MATERIALS USED IN FURNACE - CASTING EQPT CONSTRUCTION

a) List Provided b) Env Control + Purchasing become involved

4/7/73 SUBSTITUTES FOR ASBESTOS

Encouragement to find substitutes

7/28/78 * ELIMINATION OF UNNECESSARY USE OF ASBESTOS-CONTAINING MAT'LS

a) Beginning of Formal Program to get rid of unnecessary use

b) requested inventory from all plants

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7/30/79 ASBESTOS SUBSTITUTION

a) Mech Engrg Involved - Potthoma

b) List of substitutes to all plants. Request for others

2/16/82 ASBESTOS REPLACEMENT - update on substitutes

6/15/83 ASBESTOS EXPOSURES

Alcoa's Recommended Procedures/Training, Monitoring, Medical Records copy to Dale Huddleston, 12/15/87

ASBESTOS

I TOXICOLOGY + EPIDEMIOLOGY

A. Asbestosis recognized early. Limits set in 1938

B. Limit, 5 mppcf, accepted without criticism for > 30 yrs.

C. Risk was originally associated with mining + milling of 100% asbestos fiber

D. Even Selikoff in 1970 was uncertain of risk to other workers.

E. Wasn't till 70's that that risk to those with low exposures was apparent

F. In mid 60's evidence began to accumulate that lung cancer was associated w asbestos

G. Risk is with those who smoke. (Still controversial whether cause is asbestos or cigarette)

H. Epidemiology in the 70's showed convincingly that low level exposures also were of concern

II Limits

A. Limit to prevent asbestosis, 5 mppcf, set in 1938

B. In late 60's question arose, how to measure

1. Particle count – most particles were not asbestos, couldn't see fibers
2. Mass Concn – couldn't discriminate
3. Fiber count – most appropriate

C. Considerable confusion

1. ACGIH notice of intent 1968 12 f/cc (limit was still 5 mppcf)
2. ACGIH didn't change its limit til 1974 (5 f/cc same as OSHA)
3. Meanwhile ACGIH "intended" 12 f/cc or 2 mppcf picked up by OSHA via Walsh-Healey in 1971
4. OSHA ETS 7 Dec 71 5 f/cc
5. NIOSH Criteria document 1972 2 f/cc
6. OSHA Permanent Std. Jul 72: 5 f/cc, Jul 76: 2 f/cc
7. OSHA Proposal 1975 0.5 f/cc. Struck Down

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8. OSHA Permanent Std. 1976 2 f/cc as scheduled in 1972
9. NIOSH Revised Criteria Document 1976 0.1 f/cc (lowest detectable)
11. OSHA ETS 0.5 f/cc 1983. Struck Down 3/7/84
10. ACGIH 1980 crysotile 2 f/cc (crocidolite 0.2, Amosite 0.5, others 2)

III Methods

A. Published by NIOSH in Criteria Document 1972

B. OSHA guide published later

C. Membrane filter, phase contrast microscopy 430X (100X old methods) dimethyl phthalate + diethyl oxalate

IV OSHA required sampling within 6 mo after 7 July 72

Pt Comfort
IH Committee Meetings
Minutes

26 Oct 64 Hazards associated with Marinite were discussed
Hooding OK considering level of operation

25 Oct 68 Standards set requiring respirators for Marinite operations

29 Mar 68 Hygiene implications of Marinite operations. Newsletter of 25 Sep 64 reviewed

29 Jul 68 Mandatory respiratory protection for sawing Marinite + Hi Temp.
Cates + Robinson to follow thru.

23 May 69 Marinite opns to be concentrated in Bldg 13E, Exhaust system being revised.

15 Jul 69 Engineering Study. Ventilation Control not adequate in 13E

1 Dec 69 R/A approved, work on 13E ventilation system in progress

20 Feb 70 Ventilation in 13E + in pot repair, still not adequate, modifications being made.

30 Apr 70 Ventilation in 13E could be improved. Pot repair OK.

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Aluminum Company of America
ALCOA LABORATORIES

ACGIH ASBESTOS TLV'S

	TLV	Notice of Intended Change TLV
<1968	5 mppcf	—
1968	5 mppcf	12 f/cc or 2 mppcf
1969	5 mppcf	12 f/cc or 2 mppcf
1970	5 mppcf	5 f/cc and 10 f/cc ceiling
1971	5 mppcf	5 f/cc and 10 f/cc ceiling
1972	—	5 f/cc
1973	—	5 f/cc
1974	5 f/cc	—
1975	5 f/cc	—
1976	5 f/cc	—
1977	5 f/cc	—
1978	5 f/cc	0.5 - Amosite 2 - Crysotile 0.5 - Tremolite 0.2 - Crocidolite 2 - others
1979	5 f/cc	ditto
1980	0.5 - Amosite 2 - Crysotile 0.2 - Crocidolite 2 - others	—
>1980	same	—

EHL Purchased Microscope in June 1972

Membrane filter, dimethyl phthalate + diethyl oxalate

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FORM 0270 (REV 9-74)

Hueper 1955 ~100 cases of cancer coexisting with asbestosis up to 1955

Doll 1955 concluded that lung CA was specific hazard of some asbestos workers

Braun + Truan 1958 Asbestos miners in Quebec. No higher death rate from lung CA than genl population

1964-1972 increased evidence of causal relationship lung CA + asbestosis

McVittie 1965 Asbestosis takes, on average, 17 years to develop

Selikoff et al, 1968 "suggests that exposure to asbestos does not lead to an extremely high risk of lung cancer among nonsmokers."

Knox et al 1965
Mancuso et al 1967
McDonald et al 1971
Selikoff et al 1964, 65, 68
Enterline et al 1967

Studies linking lung CA with asbestos exposure

Murphy et al Dec 71 Harries "Low level asbestos as occurs in pipe coverers in new ships construction has not been considered dangerous"

Edwards, Lynch 1967 USPHS method used for asbestos (membrane filter)

Lynch + Ayer 1968 ① USPHS study in 1964 used impinger count

② impinger can't ... fibers

③ light field counting can't resolve small fibers

④ Selecting a standard method: expense of conversion from existing methods should be reasonable.

* ⑤ Fiber counts on membrane filters best method for evaluating risk

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OSHA's notice of proposed Rulemaking – Asbestos – 10/9/75

Comparatively few dust counts had been recorded on workers involved in epidemiological studies < 1968
Moreover dust counts had utilized other techniques than fiber count/membrane filter

Fiber count method came from Committee of British Occ Hyg Soc

Recommended method in 1975 proposal
USPHS/NIOSH Membrane filter method for Evaluating Asbestos Fibers
Leidel et al (in press – as of 10/9/75)

Murphy et al 1971. Did not use membrane filter method in their study

British: 4 – 15 f/cc estimated. No Asbestosis + No Cancer

~~Asbestos limit 1965? 5 mppcf~~

• PHS method ~~for dust counting~~ ACGIH Air Sampling Instr. 1963 B-3-3

Supporting Data for Asbestos ETS

As provided in 29 CFR 1953.22, the 24 States with their own OSHA-approved occupational safety and health plans are expected to adopt a comparable standard within 30 days of this publication date. These States are: Alaska, Arizona, California, Connecticut (for State and local government employees only), Hawaii, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Nevada, New Mexico, North Carolina, Oregon, Puerto Rico, South Carolina, Tennessee, Utah, Vermont, Virginia, Virgin Islands, Washington, and Wyoming.

Also, in response to the emergency conditions faced by exposed workers, OSHA is stepping up its enforcement activities in targeting workplaces where asbestos is handled.

The temporary provisions that are being added to the existing asbestos standard prescribes the major components of an occupational safety and health standard. In general, most of the current requirements remain unaffected by the emergency temporary standard. However, compliance with some requirements will be triggered by the new exposure limit of 0.5 f/cc instead of the former PEL of 2 f/cc. For example, requirements such as change rooms remain unaffected by the ETS and the trigger level for change rooms remains the former PEL of 2 f/cc (§ 1910.1001(d)(4)). However, the ETS requires that where concentrations may exceed the new PEL, the employer must post signs indicating such locations (§ 1910.1001(k)(6)).

OSHA based its decisions concerning appropriate provisions for the ETS on its determinations of the kind and degree of protective action needed to protect against a grave danger and the feasibility of instituting these provisions during the period of the ETS.

Under section 6(b) of the Act, OSHA will shortly schedule an informal rulemaking hearing on the proposed permanent changes to the standard. OSHA will also propose other revisions to the asbestos standard that will be explained in the separate notice of proposed rulemaking. Application of certain provisions of the asbestos standard to the construction industry will be raised at that time. OSHA anticipates that this notice will be published shortly. OSHA is now accepting written comments on those issues raised in the ETS which are relevant to revising the permanent rule. The Secretary must promulgate a section 6(b) standard no later than six months after publication of the emergency standard.

II. Legal Authority and Background

A. Legal Authority

Section 6(c) of the Act provides for immediately effective emergency temporary standards in certain circumstances. The Secretary has the authority to issue such a standard, without rulemaking, "if he determines (A) that employees are exposed to grave danger from exposure to substances or agents determined to be toxic or physically harmful or from new hazards, and (B) that such emergency standard is necessary to protect employees from such danger." 29 U.S.C. 655(c)(1). Thus, the danger must be "from" worker exposure and it must be "grave," not merely significant and the regulation must be "necessary" to address "such danger," not merely reasonably necessary or appropriate to provide safe employment. In addition, as in section 6(b) permanent standards, OSHA may impose requirements in the emergency standard only to the extent that they are "feasible" within the meaning of section 6(b)(5) of the Act.

The Fifth Circuit has emphasized the importance of the severity of health effects in OSHA's consideration of whether an ETS is appropriate:

> "* * * the danger of incurable, permanent, or fatal consequences to workers, as opposed to easily curable and fleeting effects on their health, becomes important in the consideration of the necessity for emergency measures to meet a grave danger." *Florida Peach Growers Association, Inc.* v. *United States Department of Labor*, 4898 F.2d, 132 (CA5).

OSHA also has interpreted relevant judicial decisions to require that its evaluation of the gravity of the danger and the necessity for emergency action must be made in the context of actual workplace conditions.

B. Background

1. *Events Leading to the ETS.* In June, 1983, OSHA received a petition for an ETS from the International Association of Machinists and Aerospace Workers (Exs. 84–244). Subsequently letters supporting this petition were received from 16 other unions (Ex. 84–284 to 84–294, 84–387 to 84–391). The petition requested an ETS to reduce the PEL to 0.1 f/cc, to modify some existing work practice requirements, and to require other protective provisions regardless of exposure level. The main reasons set forth in the petition and supporting letters are that continued exposure under current workplace conditions constitutes a grave danger and that delaying remedial action until a permanent standard is promulgated would cost large numbers of currently-exposed workers their lives. OSHA shares the genuine concern expressed by the petition and letters from unions representing thousands of employees who are directly faced with the threat of asbestos-related disease from continued exposure. And OSHA concludes that failure to issue this ETS may cost a number of exposed workers their lives.

In August 1983, OSHA completed a comprehensive risk assessment based on numerous human studies which estimated the number of excess deaths from the three major asbestos-related cancers, i.e., lung cancer, mesothelioma and gastrointestinal cancer, at the current permissible exposure level of 2 f/cc and at various reduced exposure levels. OSHA placed this document, "Quantitative Risk Assessment for Asbestos-Related Cancers", in the Asbestos docket in August 1983 (Ex. 84–349). OSHA subsequently revised this document (See Ex. 84–392).

2. *History of the Asbestos Standard.* OSHA has regulated asbestos since 1971. A 12 f/cc limit for asbestos was included in the initial promulgation of OSHA standards pursuant to section 6(a) of the Act, on May 29, 1971 (36 FR 10466). In response to a petition by the Industrial Union Department of the AFL–CIO, OSHA issued an ETS on asbestos on December 7, 1971, which established a PEL of 5 f/cc on a time-weighted average basis and peak exposures of 10 f/cc.

The current standard, promulgated in June 1972, first established an 8-hour time-weighted average PEL of 5 f/cc and a ceiling limit of 10 f/cc. The limits were intended primarily to protect employees against asbestosis, and it was hoped that they would provide some incidental degree of protection against cancer. Effective July 1976, the TWA limit was reduced by the standard to 2 f/cc. This limit has remained in effect since that time. The standard also includes provisions covering methods of compliance, monitoring, medical surveillance and housekeeping.

Court review of this standard upheld all major provisions, but remanded two issues for OSHA's reconsideration. *IUD* v. *Hodgson*, 499 F. 2d 467 (CADC 1974). These issues were whether the July 1976 date for the 2 f/cc standard should be accelerated for some industries and the adequacy of the 3 year retention period for exposure monitoring records. Subsequently, OSHA increased this retention period to 20 years (41 FR 11504) and the acceleration issue became moot.

After reviewing the then available scientific data, in October 1975 OSHA published a notice of proposed

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rulemaking to revise the asbestos standard because OSHA believed that "sufficient medical and scientific evidence had been accumulated to warrant the designation of asbestos as a human carcinogen" and that advances in monitoring and protective technology made reexamination of the standard "desirable." This proposal would have reduced the time-weighted average to 0.5 f/cc and imposed a ceiling limit of 5 f/cc for 15 minutes (40 FR 47652).

The basis for the 1975 proposal's reduced permissible level of 0.5 f/cc was OSHA's then current policy for carcinogens that no safe threshold level was demonstrable and, therefore, the Act required OSHA to set the PEL as low as technologically and economically feasible. This policy was rejected by the Supreme Court in the benzene decision (*IUD* vs. *API*, 448 U.S. 601 (1980)). OSHA limited the proposed revisions in the 1975 notice to all industries except construction. No hearing was scheduled on the 1975 proposal. Also, although OSHA announced its intention to develop a separate proposed revision applicable to the construction industry, no such proposal has been published to date.

OSHA is basing its present decision to issue an ETS, and to propose revisions to the permanent standard covering all employees, on information and analyses which postdate the 1975 proposal. Therefore, this ETS marks a new regulatory initiative, related to, but not part of the 1975 proceeding. On May 24, 1983, OSHA consulted the Construction Advisory Committee for Occupational Safety and Health (CACOSH) concerning applicability of a new asbestos standard for the construction industry. CACOSH endorsed OSHA's position that changes in the PEL made for general industry should also apply to the construction industry. OSHA is also including the comments and data received in response to the 1975 notice in the record of this proceeding, with the understanding that some commenters may have changed their positions based on intervening scientific developments and policy shifts.

In the decision to issue an ETS, the Agency has reviewed this regulatory history of asbestos. However, the Agency bases the decision to issue an ETS on the actual emergency conditions which now confront exposed workers, on epidemiologic studies that provide data to make numerical estimates of risks and on interpretations of these studies using quantitative risk analysis.

3. *The Rulemaking to Revise the Permanent Standard.* The 6(b) rulemaking initiated by this proposal is intended to be limited to the revisions made by the ETS and the additional proposed amendments raised in the notice of proposed rulemaking to be published soon. The major subjects of the 6(b) rulemaking will be: reducing the permissible exposure limit, revising the definitions of asbestos and asbestos fibers, reassessing the methods of compliance to achieve such limits, revising the provisions regarding respirator selection, revising the sampling and analytical method to improve reliability, and adding a training requirement. OSHA will also raise issues regarding the application of the permanent standard to the construction industry. As previously stated, OSHA will soon publish a separate notice of proposed rulemaking to further explain these issues.

III. OSHA's Rationale for the ETS

OSHA has determined that prevailing conditions involving worker exposure to airborne asbestos dust justify the promulgation of an emergency temporary standard. OSHA estimates that approximately 375,000 workers are exposed to asbestos at various levels (Table 1), ranging from a high value of 20 f/cc to below 0.5 f/cc. OSHA has estimated that under current exposure conditions asbestos-exposed workers face an extraordinarily high risk of contracting asbestos-related cancer whether the risk is computed over a working lifetime of exposure or for exposure periods as short as 6 months. The average excess cancer risks for all workers exposed above 0.5 f/cc using available exposure data and relying on the risk assessment are estimated as approximately 196 excess cancer deaths per 1000 workers for 45 years of exposure, 139 deaths per 1000 workers for 20 years, 10 per 1000 workers for 1 year, and 6 per 1000 workers for 6 months of exposure.

OSHA believes that risks of these magnitudes, taking into account all relevant considerations such as total numbers of workers at risk and quality of supporting data, constitute an emergency situation which requires immediate response by the agency.

The Act states that when certain statutory criteria are met, OSHA is authorized to respond to an emergency situation by issuing an ETS. The two-pronged statutory test for an ETS is that (1) employees must be exposed to a grave danger from exposure to substances or agents determined to be toxic or physicially harmful, and that (2) an emergency standard is necessary to protect employees from such dangers.

After evaluating all the evidence available to the agency concerning the severity and magnitude of the risk of asbestos-related disease to the current asbestos-exposed working population, comparing these risks to other occupational risks, applying relevant policy considerations, and reviewing all relevant judicial decisions for guidance, the agency has determined that both prongs of the statutory test are met and that an ETS should be promulgated.

For purposes of clarity, the discussion is divided into two parts, "Grave Danger" and "The Need for an ETS." OSHA believes, however, that the factors which indicate that a substance constitutes a grave danger are related to and overlap those which determine that an ETS is necessary.

A. Grave Danger

OSHA has determined that the risk to workers from exposures to asbestos at conditions that exist in the workplace pose a grave danger of death from cancer and of severe disability from the lung disease, asbestosis. In making a "grave danger" determination, the severity of the disease produced by exposure to the regulated substance and the magnitude of the predicted risks of disease must be considered. In addition, the Supreme Court has suggested that a determination of "grave danger" indicates a situation where the risk is more than "significant" (*IUD* v. *API*, *supra* n. 45).

OSHA has applied that analytic approach endorsed by the Supreme Court for "significant risk" determinations in evaluating the gravity of the danger faced by asbestos-exposed workers. The Supreme Court gave some general guidance as to the process to be followed. It recognized that while the Agency must support its finding that a certain level of risk exists with substantial evidence it also recognized that its determination that a particular level of risk is "significant" will be based largely on policy considerations (*IUD* v. *API*, 448 U.S. 655, 656, n. 62).

OSHA believes, therefore, that its determinations regarding the magnitude of the risk faced by employees should, to the extent possible, rely on quantitative expressions of that risk, utilizing the best available data.

The Court stated that the significant risk determination required by the OSH Act is "not a mathematical straitjacket," and "OSHA is not required to support its finding that a significant risk exists with anything approaching scientific certainty. ***A reviewing court [is] to give OSHA some leeway where its findings must be made on the frontiers of scientific knowledge [and that] *** the Agency is free to use conservative assumptions in interpreting the data

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with respect to carcinogens, risking error on the side of overprotection rather than underprotection" [488 US at 655, 656].

In the case of asbestos, the data available are of unusual breadth and high quality. However, because risk assessment itself involves many uncertainties, OSHA made certain assumptions in its analysis and evaluation of these data. In assessing the risk for asbestos-exposed workers, OSHA has attempted to use realistic assumptions, although the court stated that the Agency was free to use "conservative assumptions" in interpreting data. OSHA, in many cases, has indicated where different assumptions may produce different results. In addition OSHA cautions that because the risk figures finally derived are the products of a process which, as the Supreme Court acknowledged, is "on the frontiers of science," they should be viewed as approximations of the degree of risk faced by asbestos-exposed workers and not as precise fixed predictions of the number of workers who will actually develop disease.

OSHA has evaluated the kinds of dangers presented by asbestos exposure, the quantification of those dangers under present asbestos exposure conditions, the quality of the data on which risk estimates are based, a comparison of asbestos risks to other occupational risks, and relevant policy and legal considerations in concluding that workers are exposed to a grave danger from asbestos.

1. *Nature of the Diseases.* As stated above, the nature of the disease associated with exposure to a toxic substance is one of the most important elements OSHA evaluates in determining whether a grave danger exists. This factor was discussed in *Florida Peach Growers Association, Inc. v United States Department of Labor, supra.* The court, in overruling OSHA's organophosphate pesticide ETS, observed:

> We reject any suggestion that deaths must occur before health and safety standards may be adopted. Nevertheless, *the danger of incurable, permanent, or fatal consequences to workers, as opposed to easily curable and fleeting effects on their health, becomes important in the consideration of the necessity for emergency measures to meet a grave danger.* 489 F 2nd at 132 (emphasis added)

OSHA is aware of no instances in which exposure to a toxic substance has more clearly demonstrated detrimental health effects on humans than has asbestos exposure. The diseases caused by asbestos exposures are in large part life-threatening or disabling. Among these diseases are lung cancer, cancer of the mesothelial lining of the pleura and peritoneum, and asbestosis. In addition, workers exposed to asbestos are at increased risk of gastrointestinal cancer, as shown by epidemiologic studies. Although colo-rectal cancer may be curable if detected in an early stage, other gastrointestinal cancers are usually fatal. OSHA also believes that asbestos might induce cancers at other sites, which are also often fatal.

Of these, lung cancer constitutes the greatest health risk for American asbestos workers and has accounted for more than half of excess mortality in some occupational cohorts. About 90% of lung cancer patients die within 5 years of diagnosis. Mesothelioma is an incurable cancer which is usually fatal within a year after diagnosis. It is epidemiologically linked to asbestos exposure, and occurs very rarely, if at all, in persons never exposed to asbestos. Asbestosis, a type of pulmonary fibrosis, is usually non-reversible, its advanced stages are disabling, and can be fatal. OSHA concludes that all these diseases are very serious, and that the excess mortality from such severe diseases must be considered an important factor for making a grave danger determination.

2. *Degree of Risk of Developing Dangerous Disease.* OSHA based its calculations of extent of risk faced by workers under current exposure conditions primarily on the results of a quantitative analysis which derived numerical estimates of cancer risk at various cumulative exposures corresponding to levels at which workers are exposed (Ex. 84–392).

Although 2 f/cc is the current PEL for asbestos exposure, actual exposure conditions vary widely, mostly by industry segment. As explained later in this document and as set forth in Table 1, average ambient exposure levels in various industries include high exposure levels such as 20 f/cc in drywall removal, renovation and demolition; 5 f/cc in shipbuilding and repair; mid-range exposure levels such as 2 f/cc in secondary fabricating of cement sheet, packing and gaskets and paper products and rebuilding and refacing brakes; 1.5 f/cc for dry processing of textiles; and lower exposure levels such as 0.5 f/cc and 0.2 f/cc in the manufacture of floor tile.

Because OSHA is required to consider the actual danger faced by workers in assessing whether exposure to a substance presents a "grave danger", OSHA looked at the risk of developing disease not only at the 2 f/cc permissible level but at all exposure levels which workers currently face. Most of the results of these calculations for cancer are presented in Table 11 in the risk assessment section of this document.

The table sets forth predicted excess lifetime cancer risks for exposures of one year, 20 years and 45 years. Risks for exposures of 6 months are closely approximated by one-half the risks for exposures of one year. Although average exposures in demolition and renovation are estimated at 20 f/cc, the table presents risks only for selected exposure levels up to 10 f/cc.

These calculations show that the risks of asbestos-related disease are alarmingly high at current occupational exposure levels. For example, an estimated total cancer risk of 265 excess deaths per 1000 workers exists for workers exposed for a 45-year lifetime at 10 f/cc, a level which currently exists on some construction sites. At 5 f/cc, the exposure levels which are considered average in shipbuilding and repair, the risk of developing asbestos-related cancer for a 45-year exposure period is 149 excess deaths per 1000 workers. At the current permissible level of 2 f/cc which also represents actual exposure levels in such industries as secondary fabricating of cement sheet, packing gaskets and paper products and rebuilding and refacing brakes, risk is estimated as 64 excess cancer deaths per 1000 workers for a 45-year exposure period.

These risks remain very high when the period of exposure for which calculations are done is shortened to 20 years, which OSHA believes is another appropriate point for examination. The period of 20 years is the approximate midpoint between 1 year and 45 years of exposure; also many workers receive 20 years of exposure. Counterpart risk calculations using a 20-year exposure period are: for workers exposed to 10 f/cc, 140 excess cancer deaths per 1000 workers; for exposures to 5 f/cc, 105 excess cancer deaths per 1000 workers and for exposures to 2 f/cc, 44 excess cancer deaths per 1000 workers.

OSHA also estimated risks of developing cancer for a one year period of exposure at various levels to which employees are exposed. The counterpart risks for exposures to 10 f/cc for one year are: 15 excess cancer deaths per 1000 workers; to 5 f/cc, 7 excess cancer deaths per 1000 workers and to 2 f/cc, 3 excess cancer deaths per 1000 workers.

Even at current workplace exposure levels which are less than the current PEL, extraordinarily high risks of disease exist. At 0.5 f/cc, 17 excess cancer deaths per 1000 workers are

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predicted for a 45-year lifetime exposure, and 11 excess cancer deaths per 1000 workers for a 20-year exposure period.

OSHA notes that the above calculations are for cancer risk only. In addition, asbestos-exposed workers face a high risk of developing asbestosis, a disabling and often fatal disease. Predictions concerning the estimated magnitude of the asbestosis risk have been performed by OSHA and are discussed in the risk assessment section of this document. Accordingly, OSHA estimates that at 2 f/cc, 50 workers per 1000 exposed to asbestos for 45 years will develop disabling asbestosis. At 0.5 f/cc for 45 years, it is estimated that 12 workers per 1000 will develop disabling asbestosis. Asbestosis risks can also be estimated for exposures for durations shorter than 45 years. For example, the risk of disabling asbestosis from exposure to 1.0 f/cc for 22.5 years is 12 cases per 1000 workers. OSHA's estimates of the magnitude of the asbestosis risk are based on sound data from good epidemiological studies. OSHA believes, however, that the confidence which can be placed in predictions of asbestosis risk is not as great as for the predictions of cancer risk. This is because the cancer risk estimates are based on a larger and more varied data base and are derived from dose-extrapolation models that are better established. Because OSHA has determined that the risks for cancer alone indicate a grave danger, the additional risks of developing asbestosis are not necessary to justify this ETS. However, OSHA has considered that the additional and independent risk of developing asbestosis increases the danger faced by exposed workers and underscores the gravity of the health threats to employees posed by asbestos.

3. *Quality of Data on Which Risk Estimates are Based.* The underlying data upon which the quantitative risk assessments for asbestos are based are high quality epidemiologic studies, conducted in occupational environments. OSHA emphasizes that the data bases for asbestos are of unusual quality and size. Unlike most potential occupational carcinogens, asbestos has been studied often and thoroughly for evaluation of its effects on occupational populations.

In deriving these quantitative estimates for cancer risk, OSHA utilized eleven studies for the calculation of the lung cancer risk, four of which were also used to calculate the mesothelioma risk. Investigations involved "cohort" studies where the frequencies of various types of cancers in workers exposed to asbestos were compared to those in "control" groups not exposed to asbestos or to those of general populations such as U.S. males. Studies of such design are able to provide direct estimates of excess risk.

The studies used by OSHA in deriving dose-response relationships for its risk assessment covered a variety of work situations and industrial processes. This variety improves the predictive value of the risk assessment because it lessens or eliminates the possibility that the results were unique to any one occupational situation or were in fact aberrational. The occupational settings studied were: workers exposed at a chrysotile textile plant from 1930–1975 (Dement *et al.* Exs. 84–036 and 84–037); Canadian workers at an asbestos cement facility (Finkelstein Ex. 84–240); Italian chrysotile miners and millers who worked during 1930–1965 (Rubino *et al.* Ex. 84–86); workers in an asbestos cement pipe plant (Weill *et al.* Ex. 84–206); workers in an asbestos production plant and asbestos cement pipe factory (Henderson and Enterline Ex. 84–48); British workers manufacturing asbestos textile products (Peto Ex. 84–169); asbestos miners and millers in Quebec, Canada (Liddell *et al.* Ex. 84–59); and in the Thetford Mines, Canada (Nicholson *et al.* Ex. 84–72); and workers manufacturing asbestos friction materials (Berry and Newhouse Ex. 84–21).

"Well-conducted epidemiologic studies that show a positive association between an agent and a disease are accepted as the most convincing evidence about human risk" (Risk Assessment in the Federal Government: Managing the Process, National Research Council, 1983, p. 21, Ex. 84–322).

No extrapolation from animal data to human data is necessary in order to show carcinogenicity of asbestos. For most substances, OSHA must infer human health effects, such as carcinogenicity, from animal data.

The results of this risk assessment performed by OSHA agree well with other recent risk assessments performed by other governmental and outside scientists (see Acheson and Gardner) (Ex. 84–216 and 84–243); EPA (Ex. 84–180); Kang and Chu (Ex. 84–001); Selikoff *et al.* (84–002); and CHAP (Ex. 84–256).

4. *Comparative Analysis.* Insight into the magnitude of the risk associated with asbestos exposure can be gained by reviewing other occupational risks. OSHA believes it is instructive to compare asbestos risks with other workplace hazards agreed on as presenting an unusually high degree of hazard, where the data are considered both available and reliable.

The risk of excess mortality estimated as a result of exposure to asbestos at the conditions in the workplace today appears to be substantially higher than other risks experienced by workers from occupational injury hazards. The National Safety Council (NSC) has reported the annual death rates in 1981 from work accidents in a variety of industries (Ex. 84–339). Using the NSC data OSHA has reviewed the annual mortality from work accidents per 1000 workers in several industries in light of the excess cancer mortality from a single year of exposure to asbestos per 1000 workers. For example, in the high risk occupations of agriculture and mining-quarrying, the annual mortality rates from work accidents were 0.54 and 0.55 per 1000 workers respectively in 1981 (Ex. 84–339). In contrast, the death rate from work accidents for all industries combined was 0.12 per 1000 workers in 1981.

OSHA has estimated that the lifetime risk for one year of exposure to 2 f/cc of asbestos is about 3 excess cancer deaths per 1000 exposed workers during the remainder of the workers' lifetimes (Ex. 4–349). Thus, asbestos workers' risk of excess cancer mortality from a single year of exposure to 2 f/cc is roughly 5 times higher than the risk of accidental occupational fatalities from one year of employment in agriculture and mining-quarrying. 7

As shown in Table 1, OSHA estimates that many workers are exposed to asbestos in the vicinity of 2 f/cc. In addition, OSHA calculated the average excess cancer risk to workers exposed at conditions that exist in the workplace today (for those above 0.5 f/cc and using the scenario described in Table 3). OSHA estimates that 10 excess cancer deaths will occur per 1000 workers for 1 year exposure: thus the average risk to workers (exposed above 0.5 f/cc) in the workplace today is approximately 20 times the annual fatal accident rates in agriculture and mining-quarrying.

These comparisons are striking. They show that the estimated risk of dying of cancer from asbestos exposure at levels existing at the workplace today far exceeds the accidental death rate in the riskiest of industries. Although the estimated mortality rates for cancer due to asbestos exposure are not completely comparable to the total actual accidental fatalities, the review is clearly useful in showing that the magnitude of the asbestos risk is grave.

One example of predicted cancer risk as a result of occupational exposure is the following cancer risk estimated from occupational exposure to ionizing radiation. The estimated excess cancer fatality rate from 47 years of exposure to the maximum permissible occupational exposure to ionizing radiation (5 rems) is 17 to 29 per 1000 workers (Committee on the Biological Effects of Ionizing Radiation (BEIR) III predictions, see 48 FR 1902). However, most radiation standards (unlike OSHA standards) require that exposure limits be reduced to the lowest level reasonably achievable below the exposure limit (the ALARA principle). Approximately 95 percent of radiation workers have exposures less than one-tenth the maximum permitted limit. The excess cancer deaths at one-tenth the permitted level are 1.7 to 2.9 per 1000 workers exposed 47 years. Asbestos exposures of 45 years to 2 f/cc are predicted by OSHA to result in 64 excess cancer deaths per 1000 workers beginning work at age 25 (Ex. 84–392). OSHA's calculation for the average excess cancer risk to worker exposed at conditions that exist in the workplace today (for those above 0.5 f/cc) for a 45-year exposure, is 196 excess cancer deaths per 1000 workers. This figure was calculated by taking the number of cancer deaths estimated from exposure to existing conditions for 45 years for those workers exposed to greater than 0.5 f/cc of asbestos and dividing by the number of workers exposed to asbestos greater than 0.5 f/cc (multiplied by 1000).

Therefore, the excess cancer risk at 2 f/cc for asbestos workers is estimated as more than twice as high as the maximum permitted radiation cancer risk and about 25 times higher than the estimated cancer risk of 95 percent of the workers exposed to radiation. At existing conditions, asbestos workers' excess cancer risks are estimated to be 85 times higher than the cancer risk faced by 95 percent of the workers exposed to radiation. The risk of asbestosis further increases the significance of the risk from asbestos exposure.

At 0.5 f/cc, OSHA estimates that 17 excess cancer deaths will occur in 1000 workers exposed 45 years. This risk is approximately 7 times higher than the cancer risk faced by 95 percent of the workers exposed to radiation. OSHA finds that these comparative risks strongly support OSHA's finding that workers exposed to air concentrations above 0.5 f/cc are far above the point of significant risk and are at grave danger of dying from cancer.

5. *Conclusion*. OSHA's finding of "grave danger" is based on evidentiary and policy considerations. OSHA's determination that the magnitude of the estimated risk to exposed workers is alarmingly high constitutes the major component of the "grave danger" finding. The overall extraordinary degree of risk, the extent that very high risk is found in many asbestos using industries, and the unusually high quality of the data utilized to make these assessments present a very strong evidentiary basis for a "grave danger" finding. Just as importantly, the unique gravity of asbestos-caused diseases, in particular cancer, such as mesothelioma which is linked almost exclusively to asbestos exposure, strongly supports OSHA's finding of grave danger. Also OSHA's comparison of the risk of asbestos-related disease to other industrial risks underscores the extraordinarily high risk estimated for asbestos exposure. OSHA has also noted the concerns of workers about current workplace conditions and the numerous petitions for an ETS from unions representing many exposed workers. Finally OSHA has relied on its experience in evaluating and regulating workplace hazards in recognizing the extraordinary degree of risk currently faced by asbestos workers and in determining that such risk constitutes a grave danger to those workers.

B. Need for an ETS

OSHA has determined that this ETS is necessary to protect employees from grave danger, the second prong of the Act's test of OSHA's exercise of its ETS authority (Section 6(c) of the Act). As explained in detail, the effect of this ETS is to save many lives which would otherwise be lost to asbestos-related disease if current working conditions were not changed. OSHA believes that employees can be adequately protected against this grave danger only by issuing an ETS. This is because no other Agency action and no other foreseeable event would result in sufficiently reduced asbestos exposures that would alleviate the grave danger. Further, the provisions of the ETS are tailored to effect the necessary exposure reductions expeditiously.

1. *Lives Saved by Issuing an ETS*. OSHA has estimated the number of deaths avoided as a result of an ETS which would reduce the PEL to 0.5 f/cc (see Tables 2 and 3). For cancer only, based on continuing exposures under currently existing conditions for 6 months, the potential number of lives saved is estimated as approximately 210. Based on continuing exposures at currently existing conditions for 1 year, the potential number of lives saved is estimated at approximately 426. Also, OSHA has estimated that the promulgation of an ETS setting a 0.5 f/cc PEL may avoid 5725 cancer deaths assuming 20 years exposure to asbestos of the current workforce at current conditions and 7815 cancer deaths assuming 45 years exposure.

OSHA is aware, of course, that Section 6(c) of the Act limits the effective time of an ETS to 6 months, and OSHA concludes that a grave danger exists and an ETS is necessary even if OSHA focuses exclusively on this six month period. However, the Agency believes it is appropriate to calculate benefits deriving from an ETS using lifetime risks from 20 and 45 years of exposure to the PEL of 0.5 f/cc established by the ETS. Although the ETS expires within 6 months, Section 6(c) requires that rulemaking on a permanent standard also be completed within 6 months, so that there will be no gap in protection for exposed employees. In OSHA's experience and judgment, complying with this statutory directive and completing rulemaking for a permanent standard within 6 months of an ETS has and can be done.

OSHA also believes, based on its experience, that it is very likely that the PEL established after 6(b) rulemaking will be no higher than 0.5 f/cc, the ETS limit. Therefore, OSHA believes that the ETS will result in a reduced lifetime worker exposures of 0.5 f/cc or lower for 20 or 45 years, and that the benefits derived from these exposure reductions for these time periods are appropriately attributed to OSHA's promulgation of this emergency standard.

a. *Employee Exposures*. To derive these estimates of numbers of lives saved, OSHA depended on its knowledge of the following factors: (1) The employee exposure levels from the ambient asbestos air concentrations in the workplace; (2) the number of workers exposed at the various asbestos levels; (3) the duration of the exposure; and (4) the probability of the disease (or the risk) associated with the cumulative exposure.

Employee exposure levels are conventionally measured in terms of the number of asbestos fibers that are 5 microns or more in length in one cubic centimeter of air, f/cc. In these terms, an ambient concentration may seem to be a small amount of asbestos. However, in physical terms, 2.0 f/cc equals 2,000,000 fibers per cubic meter (f/m³). Humans inhale about one cubic meter of air per hour, depending on degree of physical activity. Thus, at this concentration, a worker would inhale roughly 16,000,000 fibers, 5 microns or more in length, over an eight hour workday.

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respirators (with a protection factor exceeding 10) must be worn drops from 20 f/cc (10 times the former PEL of 2 f/cc) to 5 f/cc (10 times the new PEL of 0.5 f/cc). Therefore OSHA believes that more workers will wear more protective respirators under the ETS than under the current permanent standard, that their actual exposure levels will be reduced to below 0.5 f/cc and consequently that their risks will be reduced even more than the calculations indicate.

OSHA finds also that requiring a training program to be instituted as quickly as possible is one of the most effective methods of maximizing the beneficial impact of the exposure reduction and of all the protective provisions of the current standard. Thus, the content of this ETS has been chosen as the most effective short-term strategy to reduce asbestos risks which will be accepted and implemented.

6. *Conclusion.* OSHA finds that workers exposed to asbestos in the workplace at existing exposure conditions need this emergency temporary standard to protect them from the grave danger presented by these conditions. OSHA finds that by compelling a reduction in exposure to 0.5 f/cc for those employees presently exposed over that level, many lives will be saved. Training imposed by the ETS will enhance the risk reductions, although quantification of that additional reduction cannot be calculated. 0.5 f/cc is the lowest feasible level achievable through this emergency action, where short-term implementation of the controls is required.

Only by issuing an ETS compelling reductions in exposure levels below the current permissible limit of 2 f/cc can OSHA bring about adequate reductions in risks. The administrative action of stepping up enforcement of the current standard is an inadequate response to OSHA's finding that current conditions present a grave danger.

OSHA does not believe that any significant reduction will occur within an acceptable time period without this emergency standard action. OSHA has observed a gradual reduction in asbestos use, but, in the Agency's experience, significant and rapid exposure reductions usually occur in response to standards. The provisions of the ETS will significantly reduce the risk and reduce it quickly. Therefore OSHA has determined that the ETS is necessary to reduce the grave danger.

IV. Occupational Health Data

A. Introduction

1. *Asbestos-related Diseases.* Asbestos exposure can cause a number of disabling and fatal diseases. Among these diseases are lung cancer, cancer of the mesothelial lining of the pleura and peritoneum, and asbestosis. It is also likely that asbestos increases the risk of gastrointestinal cancers. Of all the diseases caused by asbestos, death from lung cancer constitutes the greatest health risk for American asbestos workers. Lung cancer has been responsible for over half of the excess mortality from asbestos exposure in some occupational cohorts.

The relationship between lung cancer and asbestos exposure has been established by numerous epidemiologic studies of diverse groups. Asbestos-induced lung cancer usually has a latency period in excess of 20 years and may be diagnosed at an earlier age than for non-exposed persons (Craighead et al., 1982; Ex. 84–033). Few cases of lung cancer are curable despite advances in medical and surgical oncology. Only 9% of lung cancer patients survive five or more years after diagnosis (American Cancer Society, 1983; Ex. 84–160). Asbestos exposure acts synergistically with cigarette smoke to multiply the risk of developing lung cancer.

Mesothelioma also has been conclusively shown to be associated with asbestos by many studies. In some asbestos-exposed occupational groups, 10%–18% of deaths have been attributable to malignant mesotheliomas. Malignant mesotheliomas of the pleura and peritoneum are extremely rare in persons not exposed to asbestos. Generally, a latency period of at least 25 to 30 years is required in order to observe mesotheliomas in an occupational cohort. Some victims of mesothelioma have had a latency period exceeding 40 years since their initial exposure to asbestos (Craighead et al., 1982; Ex. 84–033). This form of cancer is rarely curable and is usually fatal within a year after diagnosis. There is no evidence for a relationship between cigarette smoking and mesothelioma risk.

Asbestos exposure can cause pleural and/or other pulmonary disease. Pleural plaques are one of the markers of exposure and may develop within 10 to 20 years after the initial exposure. Plaques are opaque patches visible on chest X-rays that consist of dense strands of collagen (connective tissue protein) lined by mesothelial cells. All commercial types of asbestos induce plaques. Plaques can occur even when fibrosis is absent and do not seem to reflect the severity of pulmonary parenchymal disease. Pleural calcification is also commonly found in persons who have been exposed to asbestos (Craighead et al., 1982; Ex. 84–033).

Asbestosis is pulmonary fibrosis caused by the accumulation of asbestos fibers in the lungs. Adverse effects of asbestosis range from shortness of breath upon exertion to cyanosis, effusions of serous fluid, respiratory failure, cardiac decompensation, and death. Often, asbestosis is a progressive disease, even in the absence of continued exposure. Symptoms of disease are shortness of breath, cough, fatigue, and vague feelings of sickness. When the fibrosis worsens, shortness of breath occurs even at rest. One clinical feature of early asbestosis as well as other lung diseases is end-inspiratory crackles (rales). Diagnosis of asbestosis is based upon the presence of characteristic radiologic changes, symptoms, rales, other clinical features of fibrosing lung disease and a history of exposure to asbestos. Cigarette-smoking asbestos workers may have an increased risk of asbestosis relative to non-smoking asbestos workers. (Craighead et al., 1982; Ex. 84–033).

Some epidemiologic studies have observed increases in esophageal, stomach, colo-rectal, kidney, laryngeal, pharyngeal, and buccal cavity cancers. While the magnitude of increased cancer risk for these sites is not as great as for lung cancer and mesothelioma, the increased risk is nevertheless of considerable importance because of the high background rates of some of these tumors in the general population. A 50% increase in a common cancer such as colo-rectal cancer results in many more deaths than a 50% increase in a rare cancer. Colo-rectal cancer, if detected and treated in an early localized stage, has a five year survival rate of about 70% (American Cancer Society 1983; Ex 84–160). Surgical and medical treatment is less successful for the other sites listed above.

Adverse effects from exposure to asbestos have been observed in workers involved in asbestos cement pipes and shingles manufacturing (Enterline et al., 1973a, 1973b; Weill et al., 1979; Finkelstein, 1982, 1983) (Exhibits 84–122, 84–123, 84–206, 84–044, 84–240), asbestos mining and milling (Wagner et al. 1960; Liddell et al., 1977; McDonald et al., 1980; Hobbs et al., 1980; Nicholson et al., 1979; Rubino et al., 1979) (Exhibits 2–21, 84–059, 84–065, 84–132, 84–072, 84–086), asbestos textile manufacturing (Doll, 1955; Peto et al., 1980; Berry et al., 1979;

Dement et al., 1983) (Exhibits 84-040, 84-169, 84-020, 84-037), insulation work (Selikoff et al., 1979) (Exhibit 84-090), shipbuilding (Selikoff et al., 1979; Blot et al., 1980; Tagnon et al., 1980) (Exhibits 84-091, 84-109, 84-182), and in a variety of asbestos products manufacturing industries (Jones et al., 1980; Henderson and Enterline, 1979; McDonald and McDonald, 1978; Seidman et al., 1979; Robinson et al., 1979; Acheson et al., 1981) (Exhibits 84-138, 84-048, 84-154, 84-087, 84-082, 84-103).

It should be noted that 2 fibers per cubic centimeter, which is the current OSHA standard, is equivalent to 2 million fibers per cubic meter of air. Because humans breathe in about a cubic meter of air every hour, depending on physical exertion, the current OSHA PEL for asbestos allows workers to inhale 2 million asbestos fibers per hour during an 8-hour work day. For the sake of brevity, subsequent discussion in this preamble will express exposure in terms of fibers per cubic centimeter (f/cc) rather than fibers per cubic meter.

Note.—The current OSHA standard includes asbestos fibers 5 micrometers or more in length, thereby excluding shorter fibers. Since up to 98% of airborne asbestos fibers are shorter than 5 micrometers, workers may inhale up to 100 million asbestos fibers per hour during an 8-hour work day.

Since OSHA's publication of a notice of proposed rulemaking in 1975, additional studies have confirmed that asbestos exposure causes a high risk of cancer. In addition, much more complete data on the nature of dose-response relationships for asbestos-induced diseases are now available. These studies generally indicate that the PEL set by OSHA in 1972 is inadequate to protect asbestos workers from either lung disease or cancer.

The following agencies and organizations have reviewed the health data for asbestos: International Agency for Research on Cancer (IARC) (1977, Ex. 84-321), Organization for Economic Cooperation and Development (OECD) (1979, Ex. 84-337), NIOSH (1976, 1980, Exhibits 84-338 and 84-320), Advisory Committee of the Health and Safety Commission of the United Kingdom (1979, Ex. 84-216), the Chronic Hazard Advisory Panel on Asbestos (CHAP) (1983, Ex. 84-256), and the U.S. Environmental Protection Agency (1982, Ex. 84-180). All of these groups have concluded that there is a causal relationship between asbestos exposure and the development of cancer and non-malignant respiratory disease. NIOSH recommended reduction of the PEL for asbestos to 0.1 fibers per cubic centimeter (0.1 f/cc) in 1976. In 1980, a joint NIOSH/OSHA Asbestos Work Group stated that there was no level of exposure to asbestos below which clinical effects did not occur and recommended a PEL of 0.1 fibers per cubic centimeter (0.1 f/cc), based on the limitations of current technologies of measuring air concentrations of asbestos. The 1979 report of the Advisory Committee of the Health and Safety Commission of the United Kingdom, hereafter referred to in this section as the U.K. Committee, led to the reduction of the British standard for asbestos to 1 f/cc for chrysotile, 0.5 f/cc for amosite, and 0.2 f/cc for crocidolite. Currently, it appears that the United Kingdom may lower the PEL for chrysotile to 0.5.

2. *Evaluation of Risk.* OSHA's first step in analysis of risk of disease from exposure to a potentially hazardous agent is a qualitative evaluation of scientific data. This evaluation involves reviewing human and experimental studies to consider such factors as overall study design, methods of data collection, biologic plausibility of findings, consistency of findings from different studies, temporal correctness of the association, and other factors as well as general scientific judgment.

Subsequently, after a specific agent has been judged to be hazardous, the quantitative exposure-response relationships between the agent and disease can be investigated. The available data on air concentrations of the substance or biological indices of exposure, such as fiber contents within lungs, can be reviewed for cohorts of workers demonstrated to have an increased risk of disease. If workers with an observed excess risk of disease have received cumulative exposures permitted by the current OSHA permissible exposure limit, then a potential significant health risk from exposure to the PEL has been established. If the workers with observed excess risk received cumulative exposures above those permitted by the current PEL, then risk from the current PEL may be estimated from risk observed at higher levels by using dose-response extrapolation models.

The section, *Epidemiologic Evidence on Risk from Exposure at the Current PEL*, will discuss the extent to which excess risk has been *observed* from low exposures to asbestos. Section V., *Quantitative Risk Analysis*, will discuss the *prediction* of excess risk from low asbestos exposures using dose-extrapolation models based on studies observing excess risk in humans. OSHA considers that both risks *observed* by studies and risks *predicted* by dose-extrapolation models are valid indicators of the existence of significant health risks.

Exposure data frequently are not available for workers exposed before 1970. Where historical exposure data are available, the data often have such limitations as having been collected and analyzed using industrial hygiene techniques no longer in use or having been collected in only some areas of the worksite or having been collected on only a few occasions. Therefore, of necessity, estimates of dose-response based on epidemiologic studies will have a fairly broad range of uncertainty. OSHA must examine the best available data on exposure-response to arrive at a determination of significance of risk, despite inherent and inevitable uncertainties in the data.

The current 8-hour time-weighted average PEL for asbestos of 2 fibers per cubic centimeter (2 f/cc) envisages that workers will not receive a cumulative exposure exceeding 100 f/cc-years (=2 f/cc × 50 years of occupational exposure). For asbestos, OSHA believes that a number of studies suggest that increased risk of lung cancer, asbestosis, and mesothelioma have occurred from cumulative exposures estimated as close to or below 100 f/cc-years.

Note.—OSHA typically uses 45 years as the period of a full working lifetime for purposes of quantifying risk from exposure to toxic agents. For asbestos, many scientists have used 50 years to represent a full working lifetime. Thus, both 45 years of exposure and 50 years of exposure are used in this document for the purpose of analyzing dose-response relationships for asbestos.

In these studies, the cumulative exposures resulted from exposure *levels* greater than the current OSHA PEL of 2 f/cc for an 8-hour day. For example, workers who accumulated 100 f/cc-years could have been exposed to an average level of 5 f/cc for a period of 20 years. Section B.(3), below, discusses the epidemiologic evidence for risk from low exposures in more detail. OSHA believes that a significant health risk has been observed for cumulative exposures that could be accumulated by workers exposed to no more than the present PEL of 2 fibers per cubic centimeter (2 f/cc).

Estimates of cumulative exposure are approximations of total dose received by a worker during the period of employment involving exposure to asbestos. Cumulative exposures generally are estimated by multiplying the varying intensities of exposure, such as the 8-hour time-weighted averages, by the number of year's exposed. Most theories of the mechanism of

1975 proposal shot down by ... decision

be separately coded in the international classification of diseases. It may account for one death in several thousand in the absence of an environmental or occupational asbestos exposure. In some groups of asbestos workers, it may account for one death in ten.

Once established, the other asbestos associated cancers differ little from those occurring in the general population, although there may be variations in the location of the primary site. Appropriate treatment and prognosis follow for the particular tumor. There is very limited long term survival from lung cancer therapy; and only somewhat better from treated cancer of the colon or rectum.

Asbestosis and asbestos cancer—whether it be lung cancer, pleural mesothelioma, peritoneal mesothelioma, cancer of the stomach, colon, rectum—usually do not become clinically evident until more than 20 years have passed from onset of exposure. This time-frame is now widely recognized. While some such cancers may appear during the second decade following onset of occupational exposure, peak incidence is often not noted until the 30-years-from-onset point, or later. This is true both with regular, long-term asbestos work, and following short-term, brief or intermittent exposures. While variations in the time of occurrence may depend upon intensity and duration of exposure, with heavier exposure often being associated with shorter latency periods, variations among individual cases make it impossible to predict the latency period for the risk of any particular worker.

B. PRIOR HISTORY

In 1971, in response to a petition of the Industrial Union Department, AFL-CIO, OSHA considered development of a standard regulating occupational exposure to asbestos. At that time, it had been well established that asbestosis was a major cause of disability and death among workers regularly exposed to asbestos dust in occupational circumstances in the United States, where the principal opportunity for such exposure occurred in the manufacture of asbestos products, and their use (Mancuso and Coulter, 1963; Selikoff, Churg and Hammond, 1964; Selikoff, 1965; Enterline and Kendrick, 1967; Selikoff, Hammond and Churg, 1968). The hazard of lung scarring resulting from the inhalation of asbestos ("asbestosis") had been a continuing problem from the time of its first identification (Departmental Committee, 1907; Cooke, 1924; Merewether and Price, 1931 and Dreessen, et al, 1938).

Data suggest that the incidence of asbestosis would be markedly diminished by reduction of occupational exposure to identified levels, in factories and during end product use. The British Occupational Hygiene Society reported in 1968 (Subcommittee on Asbestos, British Occupational Hygiene Society, 1968) that it had been given data by a single large asbestos textile mill which indicated that there was comparatively little clinical and/or roentgenological evidence of asbestosis at this factory in a survey completed in 1966. Recent measurements, using modern fiber-counting methods, were correlated with earlier dust assessments using other techniques. This allowed estimates of 4-15 fibers/ml to be made of worker's exposures since 1933 in the factory (Berry, 1973). These reported data carried considerable weight because information on both exposures and their effects were available. Moreover, all of the 290 individuals examined and x-rayed by the company medical department had been employed for at least 10 years; 112 had been employed for 20 years or more. There had thus been some opportunity to observe the incidence of asbestosis associated with longer exposure to asbestos, a factor of some importance since abnormal findings are often not seen until a significant period of time has elapsed from first exposure.

The Committee of the British Occupational Hygiene Society, in evaluating the information given to it on the recorded exposures in this plant and the infrequency of disease among the workers exposed to dust at these levels, came to the conclusion that, by lowering the permitted level still further, to 2 fibers/ml as a time-weighted average, employees could be permitted to work in such environments for a full working life-time (50 years) without substantial risk of developing asbestosis. It was calculated that workers exposed to 100 fiber-years/ml, that is, to 2 fibers/ml for 50 years, 4 fibers/ml for 25 years, or 10 fibers/ml for 10 years) would have a 1% risk of developing early signs of asbestosis.

The British Committee published in 1968 its report "Hygiene Standards for Chrysotile Asbestos" for the prevention of Asbestosis" in 1968. At the time, there were few data of comparable nature in the United States. While extensive clinical and epidemiological studies of the health effects of asbestos exposure on American workers had been made, comparatively few dust counts had been recorded during the years in which the exposure of these workers had occurred. Moreover, the dust counts that had been taken had utilized techniques other than the new membrane filter counting methods. For these reasons, NIOSH, in its evaluation of considerations relating to a standard for occupational exposure to asbestos (NIOSH, Criteria Document, 1971) stated that the recommendation of the British Occupational Hygiene Society was "given great weight in the development of this standard."

The asbestos standard set by OSHA in 1972 was thus based on a number of well-characterized observations. Lung scarring ("asbestosis") had been described as an important complication of occupational exposure to asbestos during the original descriptions of the problem in Great Britain. It had been found equally important in U.S. studies in the 1930's, and more recent investigations in the 1960's had demonstrated that it had continued as a serious problem. However, from the British Occupational Hygiene Society's evaluation of factory data relating the incidence of disease it appeared that the recognized, continuing important health hazard of asbestosis could be controlled on the basis of current observations.

It was known at the time that asbestosis was not the only disease that could occur as the result of asbestos exposure. Reports were available that workers so exposed were also at increased risk of developing several types of cancer, and these reports had demonstrated that such risks were present during the use of asbestos in the United States, in factory production of asbestos products, and in their subsequent use (Mancuso and Coulter, 1963; Selikoff, Churg and Hammond, 1964; Enterline and Kendrick, 1965). However, these data had not yet been fully evaluated in terms of the extent of risk in large parts of the asbestos industry in the United States and there were few data which would allow judgment concerning intensity and extent of exposure to asbestos in relation to the subsequent risk of asbestos-associated cancer. The British Occupational Hygiene Society's Committee had recognized this problem in Great Britain as well, but developed its standard based on information related to the risk of developing asbestosis, noting in its report (1968) that it was "not possible, at this time, to specify an air concentration which is known will be free of [cancer] risk. In setting its standard, OSHA hoped that reduction of exposure levels designed to prevent asbestosis would also serve to control the hazard of asbestosis-associated cancer. In this, it placed considerable reliance on an additional facet of the British experience. Concurrently, a published report from the same factory by its medical director and recognized statisticians (Knox, Holmes, Doll and Hill, 1968) had indicated that no significant increase in cancer mortality had been found among workers first employed in this plant subsequent to 1933, when the improved conditions mandated by the 1931 Factory Regulations came into effect.

Since the promulgation of the U.S. permanent asbestos standard, considerable new information has been forthcoming on the toxic effects of asbestos. This has been in two areas: in the widening spectrum of cancers associated with asbestos exposure, and in various manifestations of asbestos disease in individuals exposed to relatively low concentrations of dust. This extension of the initial data within recent years now requires refocusing of OSHA's concerns from a primary function of prevention of asbestosis with the expectation of concomitant reduction in the incidence of asbestos-associated cancer, to a new orientation, that of primary concern with the prevention of asbestos-cancer. There is an additional logic in this reorientation. Reduction of asbestos exposure to levels sufficient to prevent asbestosis is known, at least in some instances, to be insufficient to prevent asbestos-cancer. On the other hand, a reduction of asbestos exposure to an extent sufficient to prevent asbestos-associated cancer will also prevent asbestosis.

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These new observations should not diminish OSHA's prior focus on the prevention of asbestosis, since significant pulmonary and/or pleural scarring have not been an important feature of low-level, short-term, intermittent exposure. Rather, it should emphasize the incomplete perspectives of the current standard derived from considerations concerned with prevention of asbestos-related lung scarring rather than those needed for the prevention of asbestos-associated cancer, particularly mesothelioma.

C. THE NEW EVIDENCE

(1) *Asbestosis*. Subsequent to the hearings on the current standard, uncertainty has arisen as to whether the existing British asbestos standard and the mandated 2 fiber/ml U.S. standard provides effective protection even against asbestosis. The data from Great Britain obtained in 1966 indicated that little clinical disease, including x-ray evidence of asbestosis, had occurred among workers first employed in that factory at some time after 1933, when important improvements in work practices had been achieved. In 1972, results of evaluation of new x-rays that had been taken in 1970, of the work force then employed in the same factory, were reported as showing that many now had abnormal findings either in the lung or in the coverings of the lung pleurae (Lewinsohn, 1972). There was thus a difference between the prevalence of abnormal x-ray findings among workers x-rayed in 1966 as reported to the British Occupational Hygiene Society, and evaluation of other x-rays of workers in the same factory four years later.

Additionally, clinical data are becoming available concerning asbestos lung scarring in individuals exposed at levels much lower than those of occupational circumstances. Among 210 family contacts of former asbestos factory workers, 38% have been reported to have x-ray changes characteristic of asbestos exposure (Anderson, Selikoff, Lilis and Daum, 1975).

(2) *Cancer*. In December 1972, important new information on the spectrum of asbestos cancers was presented at the Conference on the Biological Effects of Asbestos, sponsored by the International Agency for Research on Cancer of the World Health Organization. At this conference, and subsequently, data on large groups of asbestos workers became available (Selikoff, Hammond and Seidman, 1973; Enterline, 1972). As expected, the high risk of bronchogenic carcinoma and mesothelioma persisted among factory employees and insulators. Moreover, these later studies confirmed the excess gastrointestinal cancer that had been suggested earlier, and extended the spectrum of asbestos related cancers.

(a) *Lung cancer*. The most important cancer afflicting asbestos workers is cancer of the lung, although mesothelioma has attracted considerable attention because of the high frequency among asbestos workers and infrequent occurrence in the population as a whole.

In many groups of asbestos workers, approximately 20% of all deaths are caused by lung neoplasms. This has been true both among asbestos product factory workers (Selikoff, Hammond and Churg, 1972; and Nicholson, 1975) and among users of these products (Selikoff, Hammond and Seidman, 1973). The exact percentage varies with circumstances of exposure, age of the workers, duration of the workers' exposure and, perhaps most of all, according to the duration from the onset of their asbestos work history. In addition, the last several years have seen the discovery of another critical variable affecting the incidence of lung cancer among asbestos workers. In 1968, Selikoff, Hammond and Churg reported that lung cancer was not significantly increased in incidence among asbestos workers with no history of cigarette smoking, although when such history was present, the incidence of lung cancer increased markedly over what would be expected among other cigarette smokers, in the absence of asbestos exposure. Thus, these scientists calculated that an asbestos worker who smoked cigarettes had 92 times the risk of dying of lung cancer, as compared with like individuals without cigarette smoking or asbestos work. This finding has been confirmed by larger studies (Hammond and Selikoff, 1973) where, again, it was found that non-smoking asbestos workers had few lung cancers while those who smoked had much more lung cancer than would have been expected had they not been asbestos workers. Calculations suggest that cigarette-smoking asbestos workers have approximately eight times the risk of developing lung cancer compared to other smokers.

(b) *Pleural and peritoneal mesothelioma*. In 1960, Wagner, Sleggs and Marchand demonstrated an important association between asbestos exposure and pleural mesothelioma. This cancer, which appears to be unrelated to smoking, had previously been considered to be a very rare tumor. Numerous reports have confirmed the finding of Wagner and his colleagues that mesothelioma can be commonly associated with asbestos exposure. A subsequent report by Enticknap and Smither, 1964, concerning workers in a British asbestos factory demonstrated that the same tumor could be commonly found in the abdomen (peritoneal mesothelioma), as well as in the chest.

The exact risk of death of these invariably fatal neoplasms has not been as well defined as has lung cancer, although recording of cases from hospitals near one large asbestos factory has indicated that it must be very common indeed (Borow, Conston, Livornese and Schalet, 1973). Information available from the experience of asbestos insulation workers suggests that approximately five to seven percent of deaths may be due to this neoplasm (Hammond, Selikoff and Churg, 1965; Selikoff, Hammond and Seidman 1973). More recently, it has been suggested that this estimate is too low, on the basis of the experience of workers in a British asbestos factory, where calculations predicted that between 10 and 11 percent of deaths would be due to mesothelioma (Newhouse and Berry, 1975).

(c) *Gastro-intestinal cancer* Gastrointestinal cancers (cancer of the stomach, colon and rectum) are also increased in incidence among asbestos workers, but the increase is less pronounced than that of lung cancer or mesothelioma. A number of studies now indicate that the increase is on the order of two or three times the number of expected tumors (Selikoff, Hammond and Seidman, 1973; Elmes, 1968). Although this increased risk is relatively limited, especially when compared with lung cancer and mesothelioma, it is nevertheless of considerable importance since a two- or three-fold increase in such common tumors becomes an important cause of death for the workers involved.

It has been suggested that other tumors are also increased in incidence among asbestos workers, particularly cancers of the larynx (Stell and McGill, 1972; Newhouse, 1973) and neoplasms of the oropharynx (Selikoff, Hammond and Churg, 1970), and of the esophagus (Selikoff, Hammond, and Seidman, 1973). However, data concerning these neoplasms are less extensive than for lung cancer, mesothelioma and gastro-intestinal cancer and further experiences are awaited. In any case, they are not very common tumors in general and any increase does not weigh heavily on the overall cancer risk of asbestos workers.

Considering all neoplasms, among some groups of asbestos workers, employed either in asbestos factory work or in the use of asbestos products, as much as 40 to 45 percent of all deaths have been due to one or another type of cancer, an approximately three-fold or four-fold increase.

Of significant importance, new data have recently been made available concerning the cancer risk of workers at the textile mill reviewed for the British standard, including those workers first employed after 1933 (Howard, Kinlen, Lewinsohn, Peto and Doll, 1975). It was found that there was excess mortality from lung cancer among those workers who entered scheduled areas after 1 January 1933. There was "clear evidence of some excess of lung cancer and respiratory deaths among those first exposed between 1933 and 1950." Equally important was the finding that "there still appears to be an excess of deaths due to lung cancer after 15 or more years' exposure" even among those first exposed in 1951 and subsequently. Indeed, it is known that mesothelioma deaths have occurred among the specific group of 290 workers whose experience prior to 1966 had led to the development of the current standard, as detailed above (Brody, J. E., 1974).

There are further data indicating the necessity for revaluation of the asbestos standard, albeit less directly derived from asbestos worker exposure. This information is derived from occurrence of asbestos cancer among individuals ex-

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to low levels of asbestos, as in environmental circumstances, or to brief or intermittent exposures to higher levels. Analysis of the history of asbestos exposure among individuals in a large series of cases of mesothelioma in Great Britain and South Africa have provided evidence that brief or intermittent exposure to asbestos may, after the passage of decades, result in mesothelioma (Greenberg and Lloyd Davies, 1974; Webster, 1973). In such circumstances, it appears that the lifetime exposure was less than the 100 fiber-years/ml envisaged by the current standard. The same discrepancy between present projected exposures and the risk of asbestos cancer exists when considering cases of mesothelioma resulting from household contact to asbestos among members of families of asbestos workers (Lillington, 1974) or among residents living in the vicinity of asbestos plants.

Of considerable industrial importance, has been the recent description of asbestos disease among shipbuilding and ship repair workers, few of whom actually work with asbestos, but many of whom were, in the past, inadvertently exposed to the asbestos dust resulting from the use of asbestos products by a relatively few of their work mates. In 1968, Harries of the Royal Navy reported cases of mesothelioma among shipyard workers at the Royal Navy dockyard in Devonport, in trades which did not directly involve worker exposure to asbestos, but in which there had been occasional opportunity for exposure merely by virtue of working in the same areas. This original finding has been widely confirmed and numerous cases of mesothelioma have since been reported in former shipyard workers (Whitwell and Rawcliffe, 1970; McEwen et al, 1970; Stumphius, 1968; Greenberg and Lloyd Davies, 1974). Studies of populations of current shipyard workers have shown much radiological evidence of asbestos abnormalities among workers in trades only indirectly exposed to asbestos in the yards (Sheers and Templeton, 1969; Fletcher, 1972).

Gillam et al (1975), studying the mortality and reviewing the chest x-rays of 439 underground metal miners exposed to an asbestiform mineral, found three times the risk of malignant respiratory disease than expected. The fiber concentrations averaged 0.24 fibers/ml.

Further, evidence has indicated that asbestos also acts as a lung carcinogen at levels much below those which will produce asbestosis. Two surveys of shipyard workers who had x-ray evidence of pleural plaques, but generally not of pulmonary fibrosis, showed a 2.5-fold excess risk of death from lung cancer and high risk of mesothelioma. (Fletcher, 1972; Edge, 1975). In a study of the mortality experience of a large U.S. asbestos products manufacturing facility, it was found that workers in low-dust areas, with a minimum risk of death from asbestosis, had the same high risk of death from various cancers as workers in dustier areas (Nicholson, 1975).

III. CERTAIN CONSIDERATIONS CONCERNING CARCINOGENICITY

In the case of asbestos, we are dealing with a substance that poses a range of health risks to the working population. These include the threat of cancer, as well as asbestosis. In considering the controversial issue of carcinogenicity, OSHA is relying upon not only the new data reviewed above, but the leading scientific principles and opinions believed to reflect the research conclusions of international cancer experts, which were developed since or not known to OSHA at the time that the original standard was promulgated.

A. THE LATENCY OF CARCINOGENIC EFFECTS

In humans, the latency period for chemical carcinogens may well extend between 20 to 40 or more years. Analogous periods exist for test animals. This means that the diesase may undergo a long development before a tumor is actually detected. At that point, it has reached a stage where removal of the worker from the workplace may be of no avail and where treatment may be extremely difficult, if not futile. Prudent policy would therefore seem to indicate that every reasonable measure should be taken to eliminate human exposure to chemical compounds as soon as their carcinogenic nature is identified.

B. VARIABILITY IN INDIVIDUAL SUSCEPTIBILITY IN RELATION TO THE CONCEPT OF A THRESHOLD

Cancer development may be influenced by such factors as the differing susceptibility of various body organs. In animal studies it has been found that individual variability in response to carcinogens is great depending upon factors such as age, sex, hormonal status, diet, and genetic factors. Thus, in the working population, certain groups, such as those already biologically compromised, may be more susceptible than other groups.

C. A "THRESHOLD" LIMIT

Because of the variability of individual response to carcinogens and other factors, the concept of a "no effect" or "threshold level" may have little real significance on the basis of existing knowledge. While some level, below which exposure to a carcinogen does not cause cancer, may conceivably exist for any one individual, other individuals in the working population may have cancer induced by doses so low as to be effectively zero. This is not to say that researchers will never find a threshold level for a carcinogenic substance, but it does mean that the threshold concept for carcinogens is, at present, more a matter of responsible regulatory policy than a precise, scientific determination.

These theoretical concepts have a bearing on the asbestos issue, particularly as to the question of the existence, or nonexistence, of a threshold level of carcinogenic effect. A "no effect" level theoretically may exist, but it has not been demonstrated.

In previous rulemaking proceedings, OSHA has considered these issues and determined that in the absence of evidence to establish a safe level on the basis of present knowledge, employee exposure must be reduced as low as feasible. (See the preambles to the carcinogen standards 29 CFR 1910.1003-10016 (39 FR 3758); the vinyl chloride standard 29 CFR 1910.1018 (39 FR 35892); the coke oven emissions proposal (40 FR 32268), and the beryllium proposal.)

OSHA welcomes all views and comments on these subjects.

IV. PERTINENT LEGAL AUTHORITY

The primary purpose of the Act is to assure, so far as possible, safe and healthful working conditions for every working man and woman. One means prescribed by Congress to achieve this goal is the authority vested in the Secretary of Labor to set mandatory safety and health standards pursuant to Section 6(b) of the Act, 29 U.S.C. 655(b). The standards setting process permits the participation of interested parties in the consideration of medical data, industrial processes and other factors relevant to the identification of hazards and the selection of appropriate control measures. Occupational safety and health standards provide notice of the permitted exposure levels and provide a basis for ensuring the existence of safe and healthful workplaces. Section 6(b)(5) of the Act, 29 U.S.C. 655(b)(5), provides that:

> The Secretary, in promulgating standards dealing with toxic materials or harmful physical agents under this subsection, shall set the standard which most adequately assures, to the extent feasible, on the basis of the best available evidence, that no employee will suffer material impairment of health or functional capacity even if such employee has regular exposure to the hazard dealt with by such standard for the period of his working life. Development of standards under this subsection shall be based upon research, demonstrations, experiments and such other information as may be appropriate. In addition to the attainment of the highest degree of health and safety protection for the employee, other considerations shall be the latest available scientific data in the field, the feasibility of the standards, and experience gained under this and other health and safety laws.

Sections 2(b)(5) and (6), 20, 21, 22, and 24 of the Act reflect Congress recognition that conclusive medical or scientific evidence, including causative factors, epidemiological studies or dose-response data, may not exist for many toxic materials or harmful physical agents. Nevertheless, standards cannot be postponed because definitive medical or scientific evidence is not currently available. Indeed, while final standards are to be based on the best available evidence, the legislative history makes it clear that "it is not intended that the Secretary be paralyzed by debate surrounding diverse medical opinion." H.Rpt. No. 91-1291, 91st Cong., 2d Session, p. 18 (1970). This Congressional judgment has been supported by the

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Current Report

Asbestos

OSHA PROPOSAL HAS ALTERNATIVE LIMITS, CONSIDERS 'FLEXIBILITY' IN COMPLIANCE

The Occupational Safety and Health Administration April 10 issued a proposed rule for occupational exposure to asbestos containing two alternative permissible exposure limits of 0.2 fibers per cubic centimeter of air or 0.5 f/cc as an eight-hour time-weighted average.

This supplemental proposal, together with the agency's Nov. 4 notice of emergency temporary rulemaking on asbestos, constitute proposed revisions to the permanent standard regulating occupational exposure to asbestos in general industry, the maritime industry, and the construction industry, according to OSHA (49 FR 14116). A 1975 notice of proposed rulemaking, which had excluded the construction industry, was withdrawn and replaced with this proposal.

OSHA noted that the emergency standard — which was struck down by a U.S. appeals court in March on the grounds that the agency failed to show any necessity for emergency action (11 OSHC 1817) — had set a 0.5 fiber limit. At that time, available evidence indicated that this level was the lowest attainable. However, the agency's current regulatory analysis indicates that for most industries, a lower limit of 0.2 f/cc is feasible, the notice stated.

In addition, OSHA is "considering allowing flexibility" in the methods chosen to achieve compliance with a PEL below two f/cc. The agency is considering allowing respirators to be used in place of engineering controls or work practices to reduce worker exposure to the lower PELs of 0.5, 0.2, or 0.1 f/cc, rather than considering respirators as a supplemental method to be used only after engineering controls and work practices have achieved maximum feasible results. Engineering controls and work practices, however, remain the mandated methods of achieving air concentrations of two f/cc.

An informal rulemaking hearing is scheduled to be held at 10 a.m. on June 19 at the Department of Labor, the notice stated.

In addition to believing that employees exposed to asbestos at the previous two f/cc limit face a significant risk to their health, OSHA stated that it "also believes that a significant risk remains at exposures to the proposed alternative PELs." However, recent available evidence indicates that either 0.2 f/cc or 0.5 f/cc is an appropriate limit to propose in light of feasibility limitations, particularly regarding asbestos measurement accuracy at low levels, according to the notice.

At the conclusion of the rulemaking, OSHA plans to adopt a PEL which reflects evidence in the record concerning health risk and technical and economic feasibility, and which may be higher or lower than the limits proposed.

OSHA Seeks Comment

The agency requested submission of written comments, data, and other evidence from interested persons on several major issues raised in the proceeding including:

- What exposure limits would provide protection of employees against known and suspected workplace hazards of asbestos and what feasibility limitations exist in setting any given limit.
- Whether the permissible ceiling limit should be reduced and, if so, what the revised limit should be.
- To what extent, if any, should the standard be modified for workplaces which are of a non-fixed nature or otherwise engage a highly transient workforce.
- Whether the changes in the definitions of "asbestos" and "asbestos fiber" would clarify the standard's intended scope, and properly relate to known or suspected workplace hazards.
- Whether OSHA should modify the existing medical surveillance provisions to change the frequency of exams or their content.
- Whether an expanded medical removal program should be provided where, as a result of the medical surveillance program, it is determined that an employee is at an increased risk of material impairment of health from further exposure to asbestos.
- Whether and under what circumstances it is feasible to reliably measure asbestos concentrations at levels of 0.1, 0.2, and 0.5 f/cc.
- Whether the evidence associating asbestos exposure with lung cancer, mesothelioma, and gastrointestinal cancer is adequate and whether OSHA's assessment of risk is scientifically valid.
- Whether regulatory distinctions should be made for different asbestos fiber types.
- Whether OSHA should require the use of engineering controls and work practices to reach the new permissible exposure limits.
- Whether the provisions of the proposed standard are cost-effective.

Construction and Asbestos

In addition, OSHA is considering three different approaches to the format of regulations governing asbestos exposures in the construction industry. The approaches are: to continue to apply the same standards as amended, to all industries, perhaps adjusting certain requirements for the construction industry; to limit the scope of an asbestos standard for the construction industry to setting permissible exposure limits, with additional protection provided by recourse to relevant OSHA standards of general applicability; or to develop a separate standard for asbestos exposure in the asbestos industry.

The agency is requesting comments concerning a number of major issues, including:

- Whether the TWA permissible exposure limit adopted for general industry should apply to the construction industry.
- Whether the present requirements for initial determinations for each place of employment are feasible for non-fixed workplaces that may exist for short periods of time.
- Whether any change from the present rule should be allowed concerning sampling frequency and patterns.
- Whether the nature of the exposure patterns in demolition necessitates special provisions.

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▸ Whether more explicit fit testing requirements should be mandated for construction employment and the content of such programs.

▸ Whether the present requirements for personal protective equipment are adequate to protect asbestos workers in the construction industry.

▸ What facilities and hygiene practices are appropriate to protect construction industry employees exposed to asbestos.

▸ What, if any, recordkeeping requirements should be mandated for the construction industry.

Upon completion of this rulemaking, OSHA said it will consider whether changes in the present standard for the construction industry are warranted, and if so, what those changes should be and how they should be made. OSHA may, on the basis of information submitted as part of this rulemaking, adopt specific changes in the current standard for the purpose of addressing unique construction industry concerns. The agency also may issue a separate standard, in whole or in part, dealing with occupational exposures to asbestos in construction work, the notice remarked.

In any case, OSHA stated that it intends to codify the asbestos construction standard at the place designated for construction standards, 29 CFR Part 1926.

Written data, views, and arguments should be submitted by May 25 to the Docket Officer, Docket No. H-033C, Occupational Safety and Health Administration, Department of Labor, 200 Constitution Ave., N.W., Washington, D.C. 20210. All material submitted will be available for public inspection at the above address.

Persons desiring to participate at the hearing must file in quadruplicate a notice of intention to appear by May 10 addressed to Tom Hall, OSHA Division of Consumer Affairs, Docket No. H-033C, Room N-3635, DOL, Third St. and Constitution Ave., N.W., Washington, D.C. 20210; telephone: (202) 523-8024.

The notice of proposed rulemaking appears in the Full Text section of this issue.

Lead

D.C. APPEALS COURT WILL VACATE STAY; OSHA TO DETERMINE DATE FOR COMPLIANCE PLANS

A draft order that would vacate a current stay of two lead standard provisions for primary and secondary smelters and battery manufacturers was submitted by the Occupational Safety and Health Administration to the U.S. Court of Appeals for the District of Columbia Circuit.

OSHA was directed by the appeals court April 6 to write the draft order, at a hearing before Circuit Judges Wilkey, Mikva and Bork in the case of *United Steelworkers of America v. Auchter* (Nos. 83-1022 and 83-1126).

The court indicated it will use the OSHA draft document as the basis for an official court order vacating the stay effective June 1. The court also noted that the order would be issued "without prejudice" to rulemaking on related topics. OSHA spokeswoman Susan Fleming told BNA April 10 that the court order is expected soon.

In ordering OSHA to submit a draft order, the appeals court gave attorneys for the union and for the industry groups involved an opportunity to review and comment on the draft. This review was to have been completed by 5 p.m. April 10.

The smelting and battery manufacturing industries were granted the administrative stay in December 1982. The stay relieved employers in those industries from having to comply with lead standard provisions at 29 CFR 1910.1025(e)(3)(ii)(B) and (E), which require employers to tell OSHA how they specifically intend to achieve compliance with the lead standard, and what schedule they will follow in implementing the compliance program (Reference File, 31:8422).

In granting the stay in response to industry petitions, OSHA noted that it was at that time conducting a general re-evaluation of the lead standard, which had been issued by the Carter Administration in 1978. The stay, OSHA said, was intended to spare employers in the smelting and battery manufacturing industries any unnecessary costs that they might incur in complying with requirements that were "under agency reconsideration" (Current Report, Dec. 9, 1982, p. 563).

The United Steelworkers of America filed suit against the agency, contending that Assistant Secretary Thorne Auchter did not have authority to issue the interim and final stays. The union also argued that OSHA's reason for granting the stay was no longer valid, since the agency had not issued a revised lead standard.

Notice Superseded

Prior to the hearing, OSHA had written a notice for publication in the *Federal Register* proposing to vacate the administrative stay, and asking for public comment on the proposal within 30 days. In that notice, OSHA acknowledged that it had not issued a proposal to modify the compliance plan requirements of the lead standard.

It also noted a recent initiative by the Steelworkers, ASARCO, and the agency to develop tripartite agreements on lead controls at ASARCO plants (Current Report, Feb. 2, p. 947). Such efforts to determine feasible engineering controls "will be aided by the development of compliance plans," the notice said.

The notice was filed with the *Federal Register* the morning of April 6, before the hearing, but then withdrawn after the court issued its order for a draft document from OSHA lifting the stay.

OSHA spokeswoman Fleming noted that the agency now must determine the date on which employers in the smelting and battery manufacturing industries must have their compliance plans ready. OSHA is preparing a notice for the *Federal Register* that will propose an effective date for the compliance plan requirements, and request public comment. Fleming said that the notice probably will appear "within the next week or so," after the appeals court formally issues its order vacating the stay.

OSHA Deputy Administrator Patrick Tyson told BNA in February that a proposed lead standard revision currently under review by the Office of Management and Budget would give a five-year extension to secondary lead smelters for installing engineering controls (Current Report, Feb. 23, p. 1014). Tyson, who currently is serving as acting administrator for the agency, said April 10 that "if we do make any changes to the lead standard involving compliance deadlines, we will make appropriate revisions to the provisions covering compliance plans."

Electrical Safety

HEARING PARTICIPANTS ASK OSHA TO RELY ON NEC FOR ELECTRICAL SAFETY STANDARDS

Numerous participants in the Occupational Safety and Health Administration's public hearing on the agency's pro-

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Johns-Manville Corporation

1978 Annual Report

JM

"...relying upon basic business philosophies and concentrating on superior products and services, controlling expenses and expanding in areas of high return..."

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During 1978 the media continued its sensationalized coverage of the lawsuits and government hearings involving occupational health and asbestos-related diseases. It is a credit to the officials of the Environmental Protection Agency and the Occupational Safety and Health Administration that they have maintained a rational and scholarly approach to the asbestos situation in the face of so many exaggerated claims by the media and plaintiff lawyers.

Throughout history whenever there has been adversity or tragedy, men have sought a scapegoat. And, even today, it appears that our legal system is more concerned with finding a fault for every undesired happening than with providing fair and reasonable compensation for the consequences of such happenings.

It is now known that excessive inhalation of asbestos fiber can, over a period of time, cause or contribute to occupational disease. Asbestos-related disease does exist; thus, it is perhaps understandable that people would cast about for an "asbestos scapegoat." What is inexcusable is the manner in which many lawyers, the media, and even some in the "public interest" arena have sought to exploit the tragedy of asbestos-related disease through the repetition of inaccuracies, half-truths and exaggerations.

The evidence does not support the allegations leveled at J-M, and we want you, our shareholders, to know the facts.

Statements on asbestos and health by the media and some officials have been inaccurate, incomplete, exaggerated and sensationalized.

All too familiar are the tendencies of the media to capitalize on and sensationalize tragedy and the eagerness of some in the public eye to grab for quick and easy headlines. Nowhere has this been more evident than in the treatment of asbestos and health issues. While some of the untruths presented by the media and others may be from lack of facts, which in itself is inexcusable, far more often they have resulted from a deliberate distortion in the face of facts and out of a very apparent anti-business bias. For example:

A reporter from a leading New York daily newspaper stating to a person being interviewed about asbestos that she was "not interested in facts—only a story."

A financial daily newspaper failing to publish vital medical information on smoking and its direct relationship to lung cancer in asbestos workers.

Television producers carefully editing answers of J-M officials to conform to an apparently preconceived story line.

A reporter from a Washington, D.C. daily refusing to explore fully the particular dangers of cigarette smoking in conjunction with asbestos exposure because he was only interested in a cover-up story.

A newspaper in Norfolk, Virginia publishing a headline misrepresenting the ruling of a United States District Court judge.

A cabinet official speculating on disease estimates without disclosing the almost total lack of scientific support for the figures.

A Congressman issuing press releases and making inflammatory comments based only upon information supplied by attorneys for people suing the asbestos companies.

A "journalist" attacking J-M in *Environmental Action* magazine, producing an article so inaccurate and vicious as to suggest malice.

These examples are not fiction, but merely a few of many instances we have witnessed which exhibit the philosophy, "a good story at any cost." All too often reporters and others have dutifully published as fact the adversary conclusions fed them by lawyers suing J-M. One can but conclude that fantasy and sensationalism make better copy than fact, and that fantasy and sensationalism it shall be.

The asbestos-related diseases of today are a result of past high exposures which were thought to be safe at the time by the United States Public Health Service.

Unfortunately, asbestos-related diseases have a long latency period; that is, a long period of time between first exposure and onset of any disease. Accordingly, we know that

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the asbestos-related disease being seen today is the result of exposure of 20, 30 and 40 years ago when medical knowledge concerning asbestos was only a fraction of what it is today.

In years past people were exposed to airborne asbestos particles in excess of what is now considered a safe exposure level. In 1938, limits for exposure to asbestos were recommended by the U.S. Public Health Service and adopted shortly thereafter by the American Conference of Governmental Industrial Hygienists, and these limits were accepted by industry as safe working conditions for employees. Further, these levels were accepted without criticism by government health officials and the medical and scientific communities for over 30 years. Knowledge subsequently gained has shown the earlier research to be incomplete. This is the simple fact, not sensational ...but true.

Individuals exposed to asbestos-containing insulation materials are particular victims of the incomplete knowledge of earlier years.

Much of the present asbestos litigation involves individuals who were overexposed to dust from industrial thermal insulation materials which contained small amounts of asbestos (usually less than 15 percent). Incidentally, many of these persons worked in environments controlled by the government and used products which were delivered to government specifications. Scientists and physicians studied these workers and repeatedly concluded that their occupational exposures to asbestos were consistently below the "safe level" recommended by the United States Public Health Service. In fact, in 1946, eminent scientists employed by the United States Navy studied several shipyards and concluded that insulation work was "not a dangerous occupation"—a finding which went uncriticized and unchallenged in American medical literature for almost 20 years.

It was not until 1964 that the particular risk to this category of worker was clearly identified by Dr. Irving J. Selikoff of Mt. Sinai Hospital in New York City.

We are asked why earlier knowledge generated from studies of mine, mill and factory situations where workers had been exposed to 100 percent asbestos fiber did not lead to earlier knowledge of a possible hazard to those exposed to industrial insulation products. The completely different work environments and experiences were thought by the medical community to make any extrapolation from one group to another invalid. Dr. Selikoff himself indicated this very clearly and concisely in 1970, stating:

"In the asbestos mining and manufacturing industry, the risk of heavy exposure to the occupational dusts had been recognized for some years. And this primary industry has understood the need to install ventilation systems and other dust control devices to reduce the hazard. Experience had indicated that reduction of dust levels and exposures could result in greatly improved health experience among asbestos factory workers. But the extrapolation of that experience to another classification of workers—specifically those who fabricate and install insulating materials—was a more sophisticated task for clinical medicine and epidemiology."

How different things might have been had modern methods of medical research been available to the U.S. Public Health Service in those early years. How different things might have been had it not taken the scientists and physicians decades to discover that the recommended limits were not stringent enough.

Perhaps it is partly the frustration of "how different things might have been" that causes the shallow thinker to engage in hindsight and raise questions about standards of conduct. Unfortunately, such an exercise contradicts the facts.

J-M has acted responsibly to discover the cause of and eliminate occupational disease among asbestos workers.

Media representatives and some elected officials have consistently ignored J-M's intensive efforts to solve asbestos health problems and, in fact, have untruthfully portrayed those efforts. Whether such untruths have been deliberate, we leave to reasonable men to judge. But, it is clear that J-M's actions have been appropriate and proper. Some examples of action taken by J-M:

Initiation in 1930 of the first American medical studies of possible health hazards from asbestos. This was in response to information that the heavy and constant asbestos exposures in the textile mills of England might be hazardous. These studies preceded by years any independent action by the United States Public Health Service or any medical organization.

Organization in the 1930's of industry support for extended research at the Saranac Laboratories of the Trudeau Foundation, a leading pulmonary disease research facility.

Voluntary adoption and adherence to the recommended exposure limits of the United States Public Health Service.

Physical examination programs available for employees continually since the 1930's; leading research efforts in the early detection of disease.

Information prepared and distributed since the 1930's to inform employees of the work practices and protections necessary to eliminate the hazards recognized at the time.

Respirator programs installed where exposure might exceed "safe exposure levels."

Hundreds of engineering projects and millions of dollars spent for dust control, including the "invention" of equipment where none existed.

The first to place warning labels on asbestos insulation products in 1964 in response to the new evidence that dust from such products might create a hazard to people working with the products.

Continued funding of independent medical and scientific research including that of leading experts such as Dr. Irving J. Selikoff of Mt. Sinai Hospital in New York City.

Cooperative programs with industry and with labor organizations to disseminate information about asbestos and health, and to continue research.

Adoption of mandatory no-smoking programs for workers occupationally exposed to asbestos—the first broad-scale, anti-cancer program in American industry.

The historic concern of Johns-Manville for its employees is exemplified by a 1934 statement stating that it was undertaking investigations to obtain "the best practice possible for the elimination of dust and the protection of employees." Additionally:

In 1938, "It is the policy of Johns-Manville to make working conditions in its factories and mines everywhere safe, healthful and pleasant."

And today, "We equip our plants for the highest degree of personal safety, assuming it is economically and technically possible to do so. When technology is not available, or when it is not feasible economically from a competitive standpoint to make these installations, we will elect to discontinue a particular operation rather than knowingly endanger the health or life expectancy of a single employee."

The numerous allegations made in the public media inferring that Johns-Manville failed to act in a responsible manner in developing and communicating medical and scientific information on the possible health hazards of asbestos in the interest of sales and profits are false and inexcusable. The facts clearly show that nothing could be further from the truth. Johns-Manville's long history of voluntary commitment to the resolution of asbestos-related occupational disease problems is unparalleled in industry, labor or government.

The media and government have ignored the connection between cigarette smoking and lung cancer, the most serious and insidious of diseases in asbestos workers.

If it were not for cigarette smoking, lung cancer would not be a significant occupational disease problem among asbestos workers. This simple, yet crucial, fact has been repeatedly confused by the medical community and continues to be largely ignored by the media and government.

Our knowledge of the relationship of an increased incidence of lung cancer among asbestos workers is of rather recent vintage. A few cases of lung cancer among individuals with

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asbestosis were reported in the late 1930's and the 1940's, but the researchers were careful to disclaim a causal relationship. In the 1950's an English study strongly suggested an increased incidence of lung cancer. But, an industry-sponsored study of the type recommended by the American Medical Association failed to disclose any such increased incidence in the North American workers studied. This confirmed a 1956 publication by E. Cuyler Hammond, a noted scientist, Vice President of the American Cancer Society and co-author with Dr. Selikoff of many of the leading articles on asbestos-related diseases. In that study Hammond concluded that sufficient evidence did not exist to causally relate lung cancer and asbestos exposure.

It was not until the mid 1960's that enough evidence became available to show an increased incidence of lung cancer among individuals who smoked cigarettes and who were occupationally exposed to asbestos. To this day scientists disagree as to whether asbestos is causally related to lung cancer or whether it acts only as a modifier for smoking-induced cancer. However, there is agreement in the medical community on the simple fact set forth earlier: *but for cigarette smoking, lung cancer would not have been a significant health factor among people occupationally exposed to asbestos.*

One can but wonder why the media steadfastly refuses to give any significant or serious attention to the role of cigarette smoking in cancer causation. The few mentions in journals are worded so as to minimize the hazard. Courageously, Rep. Millicent Fenwick of New Jersey recognized the cigarette connection and introduced legislation to provide a system of uniform compensation for asbestos-related disease. This bill called upon the tobacco companies to join the asbestos industry and government in funding such compensation. Mrs. Fenwick's bill died in committee while tobacco subsidy payments were approved as usual.

One can but wonder why federal regulatory agencies have made no move to prohibit cigarette smoking among those occupationally exposed to asbestos. J-M has adopted such a non-smoking policy, and amazingly, some of the very same parties who attack J-M for alleged failures to protect employees are now criticizing us for restricting a worker's freedom to smoke. Frankly, it is inconceivable and intellectually dishonest for those who cry cover-up and negligence to ignore the role of cigarette smoking in causing cancer.

Charges of cover-up and conspiracy are unfounded.

Perception often substitutes for fact and reality; untruths repeated often and loudly become accepted as reality. The fact is that there simply is no credible evidence that J-M should have known of particular health hazards associated with asbestos at earlier periods of time than when we did, and there is no evidence that J-M failed to respond appropriately to medical knowledge of possible hazards as the information became available. Faced with this absence of damaging evidence, certain irresponsible members of media, elected officials and lawyers ignore the facts, alleging cover-up and conspiracy, and seek to alter the perception of J-M as a responsible corporation and employer. These allegations are a red herring. A few examples reveal the sham of such allegations:

It is claimed that J-M and others conspired in the 1930's to prevent publication of information on asbestos health issues. The fact is that the documents relied on to demonstrate a conspiracy are dated a full 10 months after the publication by the United States Public Health Service of the results of J-M sponsored asbestos medical studies—the first such studies done in this country. If suppression were a goal, publication in the United States Public Health Service reports would seem a poor vehicle to reach that goal.

J-M and others are claimed to have manipulated the data published by the United States Public Health Service. Unable to ignore the existence of industry-sponsored medical research, our detractors argue that research conducted by D[illegible] Anthony Lanza was tainted by virtue of pre-publication review of the findings. Pre-publication review is nothing sinister, and, in fact, takes place today for virtually all sponsored medical research including that sponsored by the federal government. Such allegations are deliberate untruths totally unsupported by the evidence. No one in the media has had the courage to admit that the review of this 1935 paper resulted in no substantive changes as published by the United States Public Health Service *except to accentuate one possible hazard.* This can hardly be called a cover-up. There can be but one motive for such a callous disregard of the truth—to distort, mislead, sensationalize and thereby profit from the adversity of others.

Another charge is that the industry sought to control and suppress the development and publication of medical information concerning asbestos through its research programs at Saranac Laboratories. Some elementary reasoning reveals this argument for what it is—a myth. If suppression were a motive, why would J-M lead an effort to sponsor and fund research at a leading institution? Additionally, if data were suppressed, then how does one explain the published reports of the Director of the Saranac Laboratories which annually reviewed the ongoing research projects and listed the yearly publications in leading medical journals? How does one explain the attendance of the chief medical officer of the United States Public Health Service at the Saranac Symposia to discuss ongoing research? How does one explain the efforts of J-M and others to speed up, complete and publish research even after the death of the director of the laboratory in 1946?

Some allege that J-M's settlement years ago of asbestos disease-related lawsuits meant that we knew of possible hazards to applicators or users of asbestos insulation products long before the medical acknowledgment of such a hazard in the mid 1960's. The fact is that such cases involved neither insulation applicators nor insulation products. They were cases arising out of factory operations in New Jersey, where, due in large part to J-M sponsored research, a possible hazard of continual exposure to raw asbestos fiber in a factory environment had been identified. Neither the product which contained less than 15 percent asbestos nor the work environment were comparable. The workers' claims took the form of lawsuits because in the 1930's asbestos-related illness was not covered by New Jersey workers' compensation laws.

These are facts—unglamorous facts withheld by reporters, public figures and lawyers who must rely on unsupported accusations in an effort to alter perceptions. Perceptions based upon fact are useful in moving the involved parties to a resolution of the problem. But, perceptions based upon untruthful, misleading, inaccurate and unfounded accusations can only delay a much needed consensus on this pressing societal concern.

J-M stands ready to join with responsible parties to seek adequate and uniform compensation for asbestos-related illnesses.

While the incidence of disease is diminishing and will eventually disappear, the tragic fact remains: asbestos-related disease does exist, and people have been disabled.

There are two options for dealing with this reality. J-M can continue to litigate claims in the courts, or we can seek an equitable, uniform compensation system.

Litigation is based upon a finding of fault, and with respect to asbestos-related disease, there simply is no fault on the part of J-M, a fact increasingly recognized by juries throughout the nation. Litigation is, of course, favored and fostered by lawyers in search of lucrative fees and by "media personalities" in search of sensational stories. Litigation carries with it personal hardship for everyone—delay, extraordinary expense, and uneven and uncertain results. Fortunately, there is a choice.

Forward-thinking members of Congress have concluded that the time for dwelling on fault is past, and the time has arrived to address the issue of compensation for asbestos-related disease. They have proposed a system of speedy, equitable and uniform compensation, and have called upon industry and government to share the funds responsibility of providing the funds necessary to provide compensation. While such a program will be costly, perhaps more costly to J-M than continuing to litigate claims, J-M has endorsed the concept, as has the International Association of Heat and Frost Insulators & Asbestos Workers, whose members are perhaps the most directly affected. We believe it is the only way in which those injured will be fairly and uniformly compensated without extraordinary delay and expense.

J-M and others who support such legislation have been castigated and criticized for such support. Some claim, perhaps from self interest, that such legislation would be a "bail out" of the industry.

Far from a "bail out," such a system would, in all probability, entail as great or greater costs to J-M than continuing litigation since the evidence clearly supports the conclusion that J-M acted positively and progressively, consistent with medical and scientific knowledge.

A compensation system to replace lawsuits in appropriate situations continues to gain favor among industry, labor, academia, professional task forces within the federal government and members of Congress. It is simply the most effective and efficient way to satisfy a goal of fair compensation for persons suffering from occupational disease. We will continue our support of such programs—it is the right thing to do.

There is no evidence of danger in the use of asbestos in schools or other public buildings.

Much has been made of the use of sprayed insulation containing asbestos on school ceilings. Again, the facts have been ignored in favor of headlines. Johns-Manville neither made nor sold such materials. Further, the facts are that the use of asbestos spray materials in the construction of schools or other public buildings has not been shown to be hazardous. Nevertheless, a well-designed program to determine the presence of airborne asbestos fibers in such buildings would be prudent. Should excessive levels be discovered, programs to seal or remove the material would be in order.

Fibers in most asbestos-containing products are "locked in" and safe.

In most of our asbestos-containing products, the fibers are "locked in" by cement, plastic or other binders; such fibers are not easily released during normal handling and application. We are confident that, with proper precautions, asbestos and asbestos-containing products can continue to be used without a health risk. An example of this is asbestos-cement pipe which has been in useful service in the U.S. for decades.

After an extensive study, the American Water Works Research Foundation, concluded: "No firm evidence shows that the proper use of asbestos-cement pipe poses a hazard to health by reason of ingestion of asbestos fiber."

Summary

Johns-Manville has been a leader in establishing safety precautions and has acted responsibly over the years consistent with the known facts of the health hazards of asbestos fiber. We deeply regret that many people, our friends, colleagues and employees among them, are currently suffering the effects of having years ago inhaled an excessive amount of asbestos fiber. Cigarette smokers have been especially hard hit. However, there is nothing to be gained by witch hunts to determine fault where none exists. Industry, cigarette manufacturers, government, the medical profession, labor, the scientific and academic communities and the media are all involved. Attention today should not be on assessing blame, but on how those suffering from asbestos-related diseases can be properly and fairly compensated. This is why we, as a company, are encouraging legislation which would establish uniform, equitable and comprehensive means of providing compensation for asbestos-related occupational disease.

The events of the past cannot be undone. Johns-Manville has learned from those events and, today, continues to be a leader in American industry in providing healthful working conditions and advanced medical programs for its employees.

Asbestos and Health

INTRODUCTION

Asbestos, known since antiquity, has widespread and important applications in our modern industrial society. The increased use of asbestos in the 20th century has led to recognition of the need to augment the efforts to cope with occupational hazards associated with the inhalation of excessive amounts of asbestos dust. This paper summarizes the essential uses of asbestos, the known facts about health problems associated with occupational exposure to asbestos dust, and the research being conducted to identify and reduce these health risks.

ASBESTOS – AN ESSENTIAL PRODUCT

Asbestos has many essential functions in construction, in industry and in transportation. Over the years fire-resistant asbestos has saved thousands of lives and much valuable property. For safety, fire prevention and durability, products containing asbestos are used in schools, houses, theaters, office and other public buildings, spacecraft, furnaces, boilers and firefighting equipment. The brakes on automobiles, trucks, buses and trains are dependable because asbestos is a major component of brake linings.

WHAT IS ASBESTOS?

Asbestos is the name given a family of mineral fibers, including four commercially significant varieties – **chrysotile, crocidolite, amosite** and **anthophyllite** – each of which differs from the others, physically and chemically. Studies of the relationship between asbestos and health demonstrate the importance of these differences. [1]

These mineral fibers can be divided into two main classes on the basis of their crystalline structures: serpentine asbestos and amphibole asbestos. *Chrysotile*, a flexible white magnesium silicate which can be attacked by acids, and which is the only fiber that carries a positive charge in water, is the lone member of the serpentine class. It has one major difference from the other asbestos minerals; it's generally curly rather than straight and because it is flexible it can be bent into a "U" shape. These characteristics mean that this fiber does not penetrate as deeply into the lung as do the other varieties. The other commercially significant varieties are all amphiboles. *Crocidolite* is a blue ferrous sodium silicate which is acid resistant and less flexible than chrysotile. *Amosite* is a brown ferrous magnesium silicate which is brittle and easily pulverized. *Anthophyllite* is a white magnesium silicate which is brittle and acid resistant.

NO HEALTH RISKS FOR THE GENERAL PUBLIC

In this expanding industrial society, many substances and materials that could pose health and safety hazards to industrial workers under certain conditions do not, in their finished form, carry any risks to the public. This is the situation with asbestos fiber. Research in industry on asbestos exposure has shown that there are occupational health risks associated with on-the-job inhalation of excessive amounts of asbestos dust. Also, in some circumstances in the past, there has been risk to persons living in the immediate vicinity of factories using asbestos, and to members of families of wage earners who worked in occupational exposures and brought home excessive amounts of asbestos dust on their clothes.

However, there is *no evidence* either from experience or from scientific study that anyone in the general public has ever contracted any disease from exposure to the wearing or weathering of brake linings, floor tile, roofing, wall or ceiling panels, or similar asbestos-containing items.[2] In such products, the asbestos fibers are bound with cement, plastics or other binding materials, and are not released in significant amounts in normal use.

Studies of asbestos fiber concentrations in the public air have shown them to be very low – in the order of 1/100 (0.05 asbestos fibers per cubic centimeter of air) of the maximum allowable for occupational exposures (5 fibers per cc).

The application of automobile and truck brakes does not release significant quantities of asbestos fiber to the atmosphere. Only a small fraction of the asbestos in brakes is dispersed as fiber.[4] The remainder is converted by the heat of brake application to a nonfibrous mineral, *forsterite*.

With increasing scientific interest in general air pollution problems, one of many questions being studied is whether city dwellers may be exposed to some asbestos fibers along with other dusts that are known to be in the ambient air. Further attention to this question was aroused by reports of the finding of a scant number of so-called "ferruginous (iron-like) bodies" in the autopsied lungs of some city dwellers. These microscopic bodies are composed of protein and iron pigment deposited over specks of fibrous materials that may remain in the lungs. Urban dwellers are exposed to the dust of more than a hundred different types of fiber, other than asbestos, many of which can form the core of ferruginous bodies.

Similar bodies are also found in the lungs of workers who are exposed occupationally to asbestos fibers. In such cases, they are called "asbestos bodies." This term is sometimes still mistakenly used to designate a ferruginous body, even if the central core material has not been identified as an asbestos fiber.[3]

The number of ferruginous (asbestos) bodies found in people occupationally exposed is *many times greater* than the number found in the lungs of urban dwellers. It is important to remember that the presence of the few ferruginous bodies found in the various random autopsy studies of city dwellers had no connection with either the cause of death or with any history or symptoms of pulmonary disease among the subjects, but only reflected the chance inhalation of some fibrous material in the urban air.[2]

While research continues on the subject, the facts thus far strongly indicate that the sweeping inferences that have been made with regard to the possible dangers of public asbestos air pollution are unjustified.

KNOWN AND SUSPECTED OCCUPATIONAL RISKS

Asbestosis: The industry long ago recognized the risk of a particular lung disease called asbestosis among some workers and took steps to safeguard employees. This non-cancerous disease is brought on only after inhalation of heavy concentrations of asbestos dust generally over a period of many years.[5]

Asbestosis is one of the lung diseases classified as "pneumoconioses." Among others are silicosis, from crystalline silica dust; byssinosis from cotton dust; talcosis from talc; and anthracosis from coal dust. These are considered industrial health risks against which the various industries have developed protection for the worker.

For years, the asbestos industry has taken protective measures to reduce exposures to asbestos dust and reduce the risk of developing asbestosis among workers. Practices for handling asbestos fibers have been developed to minimize generation of dust. Complex dust suppression and control systems to prevent dissemination of dust are installed in many operations. Approved respirators are required for workers where dusts are unavoidable. When used properly, these measures have been shown to afford completely effective protection.

Bronchogenic (Lung) Cancer: A number of medical studies have reported an association between asbestosis and an increased risk of a certain type of lung cancer (bronchogenic). Although the number of these cases among asbestos industry workers is only a small fraction of the total employed, the industry considers the problem a serious one. It has become the subject of considerable scientific research through statistical, clinical and pathological studies of exposed workers; through experimental studies with laboratory animals; and through studies of the physical and chemical nature of asbestos and associated minerals. Among areas of investigation are the time-dose relationship; the effect of different varieties of asbestos; the effect of excessive asbestos inhalation combined with other factors such as cigarette smoking and co-existing trace metals.

The belief that asbestos fibers do not by themselves cause lung cancer was reinforced by a 1967 study indicating that exposure to asbestos among insulating workers greatly increased the risk of lung cancer but *only* among cigarette smokers. *Among insulation workers who were nonsmokers the study showed no more than the expected rate of lung cancer.*[6] *This conclusion was re-confirmed by a study completed in 1972.*[7]

Mesothelioma: Also under study is a rare disease called mesothelioma, a tumor of the chest and abdominal cavity which is different from bronchogenic lung cancer. Recently, investigators have associated an unusually high frequency of cases of mesothelioma with exposure to asbestos in certain geographic locations. This was *originally* reported from certain South African areas where only crocidolite asbestos is produced. However, in another crocidolite mining section of South Africa, several hundred miles away, only two mesotheliomas have been found, even though similar techniques for finding these tumors have been used. No mesotheliomas have been found among workers engaged in amosite mining and milling in South Africa. Conversely, cases have been found in employees of a New Jersey factory that in the mid-1940's was making insulation from amosite fiber. These situations have raised the question as to whether factors other than asbestos are involved.[8]

In the United States, mesothelioma is reported so seldom that there are no accurate figures on its occurrence in this country. In Britain, only two cases are currently reported for every thousand cases of lung cancer from all causes.[9]

The search for the cause of this unusual disease is hampered by the fact that its diagnosis and recognition is still considered a problem among medical experts. In several countries mesothelioma registries have been set up to try to collect case histories to learn more about the tumor. It is becoming increasingly obvious that there are circumstances other than exposure to asbestos fiber that can also cause mesothelioma.[10-11] The asbestos industry through research grants is assisting in medical efforts to gain more knowledge about this rare disease.

INDUSTRIAL HYGIENE AND PREVENTIVE MEDICINE

Today, the asbestos industry has invested millions of dollars in equipment and techniques to prevent the inhalation of asbestos dust by workers in the mining and milling of asbestos and in the manufacture of asbestos-containing products. Johns-Manville continually strives to eliminate dust exposure in the mines and plants which it operates. Processing areas and machinery are equipped with dust suppression and collection devices. Major improvements have been made in fiber shipping methods. For example, Johns-Manville has inaugurated the use of special railroad cars containing pallet loads of interlocked and glue-locked bags. This procedure permits complete unloading by fork truck, eliminating manual handling of bags. Atmospheric dust levels are monitored regularly. Individual respirators are used where indicated. Employees are given physical examinations to OSHA standards. A centralized Department of Environmental Control maintains constant surveillance over conditions in all J-M plants and mines.

Johns-Manville has also conducted a program of consultation with asbestos fabricators, applicators and trade groups such as the *Asbestos Textile Institute, Asbestos Cement Products Association, National Insulation Contractors Association, and Thermal Insulation Manufacturers Association* to provide a thorough understanding of potential risks and to encourage general adherence to sound industrial hygiene practices.

Before asbestos-containing fireproofing sprays were legislated out of existence, Johns-Manville voluntarily stopped selling asbestos fiber for this purpose. The company deemed this an improper use of asbestos because of the relative impossibility of effective dust control in the spraying technique used in the United States.

The company also participated in a major cooperative effort between labor, industry, science and government to conduct a health research program for industrial workers. *The Insulation Industry Hygiene Research Program*, jointly sponsored by a labor union, the International Association of Heat and Frost Insulators and Asbestos Workers, and by Johns-Manville Corporation, was organized in 1968 at the Mount Sinai School of Medicine in New York City to develop improved methods to minimize exposure of insulation workers—men who apply and remove pipe and equipment insulations in buildings, industrial plants and ships—to dust and fumes encountered in their work. The United States Public Health Service provided consultation and technical assistance.

Studies in asbestos-using industries in England and the United States indicate that where effective dust control measures have been taken, the risks of lung diseases have been reduced.[2]

ASBESTOS HEALTH RESEARCH

Research on the health effects of asbestos has been supported by Johns-Manville since the late 1920's. At the Saranac Lake, N.Y., laboratory of the Trudeau Foundation, then one of the leading research centers for pulmonary disease in the United States, the company sponsored a program of investigations designed to determine safe asbestos dust levels and to eliminate asbestosis among workers in its mines and plants. For more than 20 years the company supported research in this laboratory, basing its continually improved dust control activities on the research findings.

Today, scientific research to identify and reduce the health risk from asbestos dust exposure is being conducted in many places throughout the world. The asbestos industry both sponsors such research and cooperates in work being done by government agencies and private medical investigators.

Johns-Manville has extended full cooperation to the U.S. Public Health Service in its 7 to 10 year study of workers employed in asbestos processing plants. This epidemiological study will assess the varying environmental factors affecting the health of more than 10,000 asbestos factory workers. In addition, the company provides funds, asbestos materials, equipment and information, as the individual situation may require, for research of such institutes as: The Industrial Health Foundation of America, The Institute of Occupational & Environmental Health, Mount Sinai School of Medicine, Tulane University, University of Pittsburgh, McGill University, St. Luke's Hospital, Cleveland, Ohio. Johns-Manville also conducts studies on technical aspects of asbestos in its own Research and Development Center in Denver, Colorado.*

In cooperation and in conjunction with other agencies, the asbestos industry will continue to seek new information about the biological effects of asbestos fiber and to develop ways of assuring maximum possible protection from occupational hazards for its employees in asbestos mines, mills and plants and among fabricators and applicators of this essential material.

EXPLANATORY NOTES

1. Because the major types of asbestos differ chemically and physically, they also differ in their biological effect on humans and in experimental animals. Current knowledge indicates that crocidolite, the type least used in the United States, is most clearly associated with health hazards for people. This is the consensus of a panel of nine medical experts appointed by the British Ministry of Labour – Christy, R. K. and members of the panel, "Problems Arising from the Use of Asbestos *Her Majesty's Stationery Office*, 1967

Wagner published experimental evidence that, compared with other asbestos fibers crocidolite produces the most severe asbestosis in laboratory animals. – Wagner, J. C., "Asbestosis in Experimental Animals." *British Journal of Industrial Medicine* 1963 20 1

Wagner et al., reported a high number of mesothelioma cases among crocidolite miners and millers in one area of South Africa, but no cases among amosite miners and millers – Wagner, J. C., Sleggs, C and Marchand, P., "Diffuse Pleural Mesothelioma and Asbestos Exposure in the North Western Cape Province." *British Journal of Industrial Medicine*, 1960, 22 261 By contrast, chrysotile mining areas in other parts of the world have exhibited either no excess or a barely perceptible excess incidence of mesothelioma.

Evidence for an important difference in risk in different occupations and with the type of asbestos has increased. The risk is greatest with crocidolite less with amosite and still less with chrysotile. – *Report of the Advisory Committee on Asbestos Cancers to the Director of the International Agency for Research on Cancer of the World Health Organization*, meeting at Lyon, France, October 5 and 6, 1972.

2. Only in occupational exposures do asbestos dust levels appear great enough to become possible health hazards. This fact is related to dosage levels as pointed out by Enterline and Kendrick: "Asbestos dust at levels to which general populations are exposed probably is of little importance in the etiology (causation) of disease." – Enterline, P E and Kendrick M A "Asbestos Dust Exposures at Various Levels and Mortality," *Archives of Environmental Health*, August 1967.

In addition investigators who report so-called "asbestos bodies" in human lungs, note that these findings are not related to cause of death or indeed to any disease. The comment of Thomson and Graves is representative of those in other studies: "But to convert the scanty or very scanty bodies which have demonstrated to be present in so many urban dwellers to the frequency present in a minimal basal asbestosis would require an increase by hundredfolds and to get a more diffuse classical asbestosis with pulmonary disability the multiplying factor might well be in many millions." Thomson, J. G. and Graves, W. M., "Asbestos as Urban Air Contaminant." *Archives of Pathology* May 1966.

"...excess lung carcinoma risk is not detectable when the occupational exposure has been low. These low occupational exposures have almost certainly been much greater than that to the public from general air pollution. There is no evidence of excess risk of mesothelioma from asbestos air pollution which has existed in the neighborhood of chrysotile and amosite mines. There is no evidence of risk to the general public at present." – *Report of the Advisory Committee on As-*

*Refer to "History of Johns-Manville Health Research." (Copies available from Johns-Manville)

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bestos Cancers to the Director of the International Agency for Research on Cancer of the World Health Organization, meeting at Lyon, France, October 5 and 6, 1972.

3. So-called "asbestos bodies" in the lung may be produced by other substances. Gross et al., have offered experimental proof: "So-called 'asbestos' bodies were produced in the lungs of hamsters injected intratracheally with respirable filamentous particles composed of aluminum silicate... Instead of the term 'asbestos' body, the designation of ferruginous body is suggested." — Gross, P., Cralley, L. J. and deTreville, R. T. P., "'Asbestos' Bodies: Their Nonspecificity," *American Industrial Hygiene Association Journal,* November-December 1967.

Similar results have been reported by Davis, working at Cambridge University, England. Davis said that hamsters were injected in the trachea and the pleura with dust from aluminum silicate, glass fiber, carborundum and man-made textile fiber. "In both injection sites all these foreign materials produced bodies which with the light microscope appeared very similar to asbestos bodies. The basic assumption that asbestos-like bodies can only be produced from asbestos has proved incorrect." — Davis, J. M. G., Gross, P. and deTreville, R. T. P., "Asbestos Bodies and Bioeffects — A Detective Story," *Annual Meeting, Industrial Hygiene Foundation,* Pittsburgh, October 1967.

4. An uninformed speculation, frequently stated as if it were a fact, is that the wearing of automobile brakes releases dangerous quantities of asbestos fiber into the air. A study by Lynch of the U.S. Public Health Service, has demonstrated that this statement is erroneous. Lynch performed laboratory tests of automotive brake linings and found that normal wear releases insignificant amounts of asbestos fiber into the air. He concluded that "the free fibers from brake lining wear appear to be an inconsequential health factor in urban air pollution." — Lynch, J. R., "Brake Lining Decomposition Products," *Journal of the Air Pollution Control Association.*

5. A time factor in asbestosis cases is demonstrated by the study of McVittie showing that clinical asbestosis takes on the average about 17 years to develop. — McVittie, J. C., "Asbestosis in Great Britain," *Annals New York Academy of Sciences,* December 31, 1965.

6. Selikoff et al., reported a much higher rate of lung cancer among asbestos workers who smoked cigarettes than among cigarette smokers generally. However, they reported not one case of lung cancer among nonsmoking asbestos workers. The authors concluded that their evidence "suggests that exposure to asbestos does not lead to an extremely high risk of lung cancer among nonsmokers." — Selikoff, I. J., Hammond, E. C. and Churg, J., "Asbestos Exposure, Smoking and Neoplasia," *Journal of the American Medical Association,* April 8, 1968.

A 1969 update of this study reported one case of lung cancer among nonsmokers — Selikoff, I. J., Hammond, E. C. and Churg, J., "Mortality Experience of Asbestos Insulation Workers 1943-1968," presented at the International Conference on Pneumoconiosis, Johannesburg, South Africa, April-May 1969.

7. Kannerstein and Churg reported in their recent study that lung cancer will not develop in asbestos workers unless they are also cigarette smokers. — Kannerstein, M. and Churg, J. "Pathology of Carcinoma of the Lung Associated with Asbestos Exposure," *Cancer,* American Cancer Society, July 1972.

8. The varying prevalence of mesothelioma in the two crocidolite mining areas of South Africa has prompted comment by Wright: "That something other than, or in addition to, asbestos plays a role in mesothelioma formation seems inescapable." Wright, G. W., "Asbestos and Health in 1969," *American Review of Respiratory Disease,* October 1969.

9. About 50 cases of mesothelioma are reported annually in Great Britain. — Gunter, R., Minister of Labour. *Official Report to the House of Commons,* April 17, 1967.

10. In a study of 76 mesothelioma patients in a London hospital, 25 had no known contact or exposure to asbestos. — Newhouse and Thompsen, "Mesothelioma in a London Hospital."

11. In a study of 232 mesothelioma cases in the South African Register, 32 had no asbestos exposure. — National Research Institute for Occupational Diseases of the South African Medical Research Council, *Annual Report,* 1971.

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