

FILE NAME: Packings and Gaskets (PAG)

DATE: 1976 Dec

DOC#: PAG027

DOCUMENT DESCRIPTION: Dept of Health - Revised Recommended Asbestos Standard

REVISED RECOMMENDED ASBESTOS STANDARD



**U. S. DEPARTMENT OF HEALTH, EDUCATION, AND
WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health**

DECEMBER 1976

For sale by the Superintendent of Documents, U.S. Government
Printing Office, Washington, D.C. 20402

VI. THE RECOMMENDED STANDARD

Available studies provide conclusive evidence that exposure to asbestos fibers causes cancer and asbestosis in man. Lung cancers and asbestosis have occurred following exposure to chrysotile, crocidolite, amosite, and anthophyllite. Mesotheliomas, lung and gastrointestinal cancers have been shown to be excessive in occupationally exposed persons, while mesotheliomas have developed also in individuals living in the neighborhood of asbestos factories and near crocidolite deposits, and in persons living with asbestos workers. Asbestosis has been identified among persons living near anthophyllite deposits.

Likewise, all commercial forms of asbestos are carcinogenic in rats, producing lung carcinomas and mesotheliomas following their inhalation, and mesotheliomas after intrapleural or ip injection. Mesotheliomas and lung cancers were induced following even 1 day's exposure by inhalation.

The size and shape of the fibers are important factors; fibers less than 0.5 μm in diameter are most active in producing tumors. Other fibers of a similar size, including glass fibers, can also produce mesotheliomas following intrapleural or ip injection.

There are data that show that the lower the exposure, the lower the risk of developing cancer. Excessive cancer risks have been demonstrated at all fiber concentrations studied to date. Evaluation of all available human data provides no evidence for a threshold or for a "safe" level of asbestos exposure.

In view of the above, the standard should be set at the lowest level detectable by available analytical techniques, an approach consistent with NIOSH's most recent recommendations for other carcinogens (ie, arsenic and vinyl chloride). Such a standard should also prevent the development of asbestosis.

Since phase contrast microscopy is the only generally available and practical analytical technique at the present time, this level is defined as 100,000 fibers $>5 \mu\text{m}$ in length/ m^3 (0.1 fibers/cc), on an 8-hour-TWA basis with peak concentrations not exceeding 500,000 fibers $>5 \mu\text{m}$ in length/ m^3 (0.5 fibers/cc) based on a 15-minute sample period. Sampling and analytical techniques should be performed as specified by NIOSH publication USPHS/NIOSH Membrane Filter Method for Evaluating Airborne Asbestos Fibers - T.R. 84 (1976).

This recommended standard of 100,000 fibers $>5 \mu\text{m}$ in length/ m^3 is intended to (1) protect against the noncarcinogenic effects of asbestos, (2) materially reduce the risk of asbestos-induced cancer (only a ban can assure protection against carcinogenic effects of asbestos) and (3) be measured by techniques that are valid, reproducible, and available to industry and official agencies.

However, some difficulties arise in that specific work practices and innovative engineering control or process changes are needed. But because of the well-documented human carcinogenicity from all forms of asbestos, these difficulties should not be cited as cause for permitting continued exposure to asbestos at concentrations above 100,000 fibers $>5 \mu\text{m}$ in length/ m^3 .

This standard was not designed for the population-at-large, and any extrapolation beyond general occupational exposures is not warranted. The standard was designed only for the processing, manufacturing, and use of asbestos and asbestos-containing products as applicable under the Occupational Safety and Health Act of 1970.

criteria for a recommended standard

OCCUPATIONAL EXPOSURE
TO
ASBESTOS



U.S. Department of Health, Education, and Welfare
Public Health Service
Health Services and Mental Health Administration
National Institute for Occupational Safety and Health

1972

I. RECOMMENDATIONS FOR AN ASBESTOS STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that worker exposure to asbestos dust in the workplace be controlled by requiring compliance with the following sections. Control of worker exposure to the limits stated will prevent asbestosis and more adequately guard against asbestos-induced neoplasms. The standard is amenable to techniques that are valid, reproducible, and available to industry and governmental agencies. It will be subject to review and will be revised as necessary.

Section 1 - Environmental (work place air)

(a) Concentration

Occupational exposure to airborne asbestos dust shall be controlled so that no worker shall be exposed to more than 2.0 asbestos fibers per cubic centimeter (cc) of air based on a count of fibers greater than 5 micrometers ($>5\ \mu\text{m}$) in length ((determined by the membrane filter method at 400-450X magnification (4 millimeter objective) phase contrast illumination, as described in Appendix I)), determined as a time-weighted average (TWA) exposure for an 8-hour work day, and no peak concentration of asbestos to which workers are exposed shall exceed 10.0 fibers/cc $>5\ \mu\text{m}$ as determined by a minimum sampling time of fifteen minutes.

(b) Sampling

Procedures for sampling, calibration of equipment, and analysis of asbestos samples shall be as provided in Appendix I.

(c) It is recommended that this Section I become effective two years after promulgation as a standard, and that until the date of

publication, the present emergency standard for exposure to asbestos dust (29 CFR 1910.93a) shall be in effect. This period is believed necessary to permit installation of necessary engineering controls.

Section 2 - Medical

Medical surveillance is required, except where a variance from the medical requirements of this proposed standard have been granted, for all workers who are exposed to asbestos as part of their work environment. For purposes of this requirement the term "exposed to asbestos" will be interpreted as referring to time-weighted average exposures above 1 fiber/cc or peak exposures above 5 fibers/cc. The major objective of such surveillance will be to ensure proper medical management of individuals who show evidence of reaction to past dust exposures, either due to excessive exposures or unusual susceptibility. Medical management may range from recommendations as to job placement, improved work practices, cessation of smoking, to specific therapy for asbestos-related disease or its complications. Medical surveillance cannot be a guide to adequacy of current controls when environmental data and medical examinations only cover recent work experience because of the prolonged latent period required for the development of asbestosis and neoplasms.

Required components of a medical surveillance program include periodic measurements of pulmonary function (forced vital capacity (FVC)), and forced expiratory volume for one second (FEV_1), and periodic chest roentgenograms (postero-anterior 14 x 17 inches). Additional medical requirement components include a history to describe smoking habits and details on past exposures to asbestos and other dusts and to determine presence or absence of pulmonary, cardiovascular, and gastrointestinal symptoms, and a physical examination, with special attention to pulmonary rales, clubbing of fingers, and other signs related to cardiopulmonary systems.

Chest roentgenograms and pulmonary function tests will be performed at the employer's expense, at least every 2 years on all employees exposed to asbestos. These tests will be made annually to individuals, (1) who have a history of 10 or more years of employment involving exposure to asbestos or, (2) who show roentgenographic findings (such as small opacities, pleural plaques, pleural thickening, pleural calcification) which suggest or indicate pneumoconiosis or other reactions to asbestos, or (3) who have changes in pulmonary function which indicate restrictive or obstructive lung disease.

Preplacement medical examinations and medical examinations on the termination of employment of asbestos exposed workers are also required.

Section 3 - Labeling

(a) A warning label for asbestos as shown in Figure 1 shall be used.

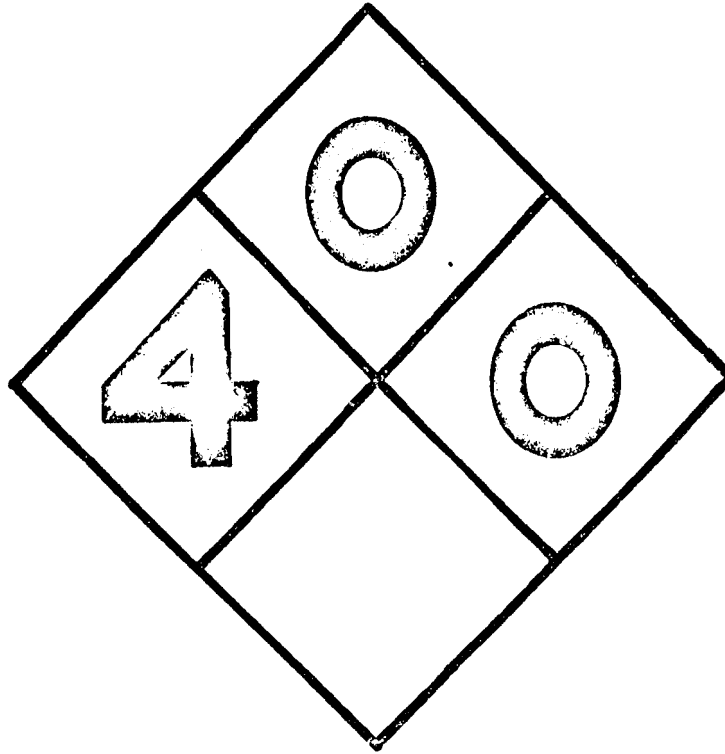
(b) Numerical designations indicate the following:

(i) 4= Health Hazard (color code, blue). Inhalation may cause asbestosis, pleural or peritoneal mesothelioma, or lung cancer.

(ii) 0= Fire Hazard (color code, red). Asbestos is non-flammable and has negligible vapor pressure, volatility, flash point, and explosive limits.

(c) The details of the numerical hazard rating system are found in Appendix II.

ASBESTOS



HARMFUL: May Cause Delayed Lung Injury
(Asbestosis, Lung Cancer).

x

DO NOT BREATHE DUST

Use only with adequate ventilation and
approved respiratory protective devices.

Summary of the Basis for the Recommended Standard

The recommendation for an environmental standard for asbestos is based upon health considerations and limited engineering feasibility data. The overriding considerations are the health effects.

Evidence indicates that past and current standards for fiber concentrations in the working places where asbestos fibers occur, though undoubtedly contributing to reduction of the severity and frequency of asbestosis, have not provided complete protection from exposure to asbestos, necessitating development of a new standard.

Consideration was given to previous reports and studies, recent data, and the present "state-of-the-art." It is recognized that additional data would be desirable to support an asbestos standard, but because of immediate need for worker protection, it is necessary to make a recommendation based on available studies and data. The following constraints in applicability of research data were considered in the development of the recommendations:

(a) Few epidemiological studies or clinical reports with supporting environmental data are available in the exposure range that must be considered.

(b) Environmental data on practically all studies were collected only over the last few years and/or they were collected by other techniques and expressed in terms other than fibers/cc.

(c) The environmental samples were expressly collected in many cases for control purposes rather than for research and, as a result, meaningful evaluations cannot be made.

(d) There is a lack of data to define with any degree of precision the threshold of development of neoplasms resulting from exposure to asbestos and the relationship of the latent period between exposure and development of neoplasms.

The standard recommended in this document is similar to the standard adopted by Her Majesty's Factory Inspectorate in 1969⁶⁶ (still in effect as of December 29, 1971), and more stringent than the recent U. S. Emergency Standard. It is felt to be feasible technologically for the control of the exposure to the worker and effective biologically for protection of the worker against asbestos-induced diseases.

Considerations of carcinogenesis indicated the need for a measure of prudence. As a result of this rationale, a factor was added to reduce the time-weighted average exposure to 2.0 fibers/cc > 5 μ m. A ceiling value of 10.0 fibers/cc > 5 μ m that was not to be exceeded was included to reduce the possibility of the short-term heavy exposures to asbestos that have been reported to cause mesothelioma. In addition, this should reduce the likelihood of diseases (malignant and non-malignant) resulting from exposures in excess of 30 years or with very long latent periods.

TABLE III-2

STUDIES OF HUMAN POPULATION CARCINOGENICITY

Author	Date	Finding	Group and Exposure
<u>Occupational Exposure</u>			
<u>Historical Studies</u>			
Lynch and Smith	1935	Suspicion of association	Asbestos workers
Gloyne	1935	Between asbestos and lung cancer	"
Wedler	1943a,b	Case reports of pleural and peritoneal tumors associated to asbestos	"
Doll	1955	Lung cancer	Asbestos textile workers employed before 1930
Mancusco and Coulter	1963	Lung cancer and mesotheliomas	Asbestos workers
Selikoff	1964	"	"
<u>Epidemiological Studies</u>			
Lung, Pleural and Peritoneum			
<u>Mixed Types of Fibers</u>			
Newhouse (UK)	1969	Bronchial cancer, pleural and peritoneal mesotheliomas	Asbestos manufacturing, insulation and shipyard workers
Bohlig et al (FRG)	1970	"	"
Selikoff et al (USA)	1970	"	"
Elmes and Simpson (UK)	1971	"	"
Stumphius (Netherlands)	1971	"	"
Rubino et al (Italy)	1972	"	"
Selikoff et al	1973	Lung cancer	Insulation workers, chrysotile and amosite asbestos exposure
Enterline and Henderson	1973	Respiratory cancer	Retired production and maintenance workers in asbestos industry
Harries	1976	Mesotheliomas	Naval dockyard workers
Edge	1976	Carcinoma of bronchus	Shipyard workers

TABLE III-2 (CONTINUED)

STUDIES OF HUMAN POPULATION CARCINOGENICITY

Author	Date	Finding	Group and Exposure
<u>Mixed Types of Fibers</u>			
DeLajarte et al (France)	1973	Evidence of association between mesotheliomas and past exposure to asbestos	Occupational exposures in some cases as brief as one day
Gobbato and Ferri (Italy)	1973	"	"
Webster (South Africa)	1973	"	"
Greenberg and Lloyd	1974	"	"
Davies (UK)		"	"
Hain et al (Fed. Rep. Germany)	1974	"	"
Nurminen (Finland)	1975	"	"
Stunn (Ger. Dem. Rep.)	1975	"	"
Zielhuis (The Netherlands)	1975	"	"
Newhouse et al	1973	Peritoneal tumors associated to heavy exposures	"
Gilson	1973	5% to 7% asbestos workers' deaths due to mesotheliomas	"
Hammond and Selikoff	1973		"
Selikoff	1976	"	"
Newhouse and Berry	1975	11% asbestos workers deaths due to mesotheliomas	"
<u>Single Types of Fibers</u>			
<u>Crocidolite</u>			
Wagner	1960	Pleural and peritoneal cancer	Workers in mines, mills and in transportation and handling of crocidolite and population in vicinity of mines
Harrington et al	1971	Mesotheliomas	Mining population of crocidolite mines
Webster	1973		
McNulty	1962	"	Miners of crocidolite
Jones et al	1976	"	Women working with crocidolite in WWII gas mask canister factories

TABLE III-2 (CONTINUED)

STUDIES OF HUMAN POPULATION CARCINOGENICITY

Author	Date	Finding	Group and Exposure
<u>Chrysotile</u>			
McDonald et al	1973,1974	Lung cancer	Chrysotile mine and mill workers
Kogan et al	1972	Total cancer Lung cancer	Workers in asbestos mining and milling, men and women
Wagoner et al	1973	Respiratory cancer	Workers in manufacturing of textile, friction and packaging products using chrysotile
Enterline and Henderson	1973	"	Men 65 yr and older, retired production or maintenance employees in asbestos industry exposed only to chrysotile
Borow et al	1973	Mesotheliomas	Workers at plant using chrysotile, all ages
<u>Amosite</u>			
Gilliam et al	1976	Malignant respiratory disease	Miners exposed to amphibole fibers in cummingtonite-grunerite ore series
Selikoff et al	1976a,b	Mesotheliomas, lung cancer	Insulation workers in factory using amosite
<u>Anthophyllite</u>			
Neurman et al	1974	Bronchial cancer, dyspnea and cough	Anthophyllite mining employees
<u>Other Cancer</u>			
Mancuso and El Attar	1967	Cancer of gastrointestinal tract	Asbestos workers
Elmes and Simpson	1971	"	"
Kogan et al	1972	"	"
Newhouse	1973	"	"
Wagoner et al	1973	"	"
McDonald et al	1974	"	"
Selikoff et al	1974	"	"
Stell and McGill	1973	Squamous carcinoma of larynx	Workers with exposure to asbestos
Morgan et al	1976		
Newhouse and Perry	1973	Cancer of larynx	Asbestos workers

TABLE III-2 (CONTINUED)

STUDIES OF HUMAN POPULATION CARCINOGENICITY

Author	Date	Finding	Group and Exposure
<u>Nonoccupational Exposure</u>			
Anderson et al	1975	Mesotheliomas	Family members of asbestos workers
Wagner et al	1960	"	Individuals in neighborhood of industrial sources of asbestos
Newhouse and Thompson	1965		
Bohlig and Hain	1973		
Gilson	1970	"	New cases from areas with recognized industrial source of asbestos
Greenburg and Lloyd	1974		
Davies			
Kiviluoto	1960	Pleural plaques	Persons in farming region of Bulgaria where minute quantities of anthophyllite, tremolite and sepiolite in soil and non-occupationally exposed persons in anthophyllite mining area of Finland
<u>Other Studies</u>			
Newhouse	1969-	Cancer, mesothelioma	Women factory workers exposed to chrysotile, amosite and crocidolite
Newhouse et al	1972	"	
Howard et al	1976	Lung cancer	Workers in asbestos industry from 1933 to 1950 and after 1950
Cooper et al	1975	"	Sheet metal workers with 5 or more years exposure