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Part II

Department of Labor

Occupational Safety and Health
Administration

29 CFR Parts 1910 and 1926
Occupational Exposure to Asbestos,
Tremolite, Anthophyllite, and Actinolite;
Final Rules

June 20, 1986

DEPARTMENT OF LABOR

Occupational Safety and Health Administration

29 CFR Parts 1910 and 1926

[Docket No. H-033C]

Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite

separate standards and separate statements of reasons (Summary and Explanation sections) have been developed to apply to general industry (including maritime) and to construction, because the differences in exposure and workplace conditions in general industry and construction workplaces warrant separate treatment. The standards will be codified in 29 CFR Parts 1910 and 1926, OSHA's General Industry and Construction standards, respectively. The basis for promulgation of these regulations is a determination by the Assistant Secretary that employees exposed to asbestos, tremolite, anthophyllite, and actinolite face a significant risk to their health and that these final standards will substantially reduce that risk. The record in this rulemaking demonstrates that employees occupationally exposed to asbestos are at risk of developing such chronic diseases as asbestosis, lung cancer, pleural and peritoneal mesothelioma, and gastrointestinal cancer.

The standards also provide for requirements for methods of compliance, personal protective equipment, employee monitoring, medical surveillance, communication of hazards to employees, regulated areas, housekeeping procedures, and recordkeeping. An "action" level of 0.1 f/cc as an 8-hour time-weighted average is established as the level above which

set initial activities, medical surveillance, and employee exposure monitoring results indicate that the exposures of employees do not exceed the level the employer is not in compliance with many of the requirements. The 0.2 f/cc does not indicate a significant risk from exposure as considered by OSHA. Substantial evidence in the record, to be the lowest level

The amended standards today take effect except the following which contain information statements which are under review: (1) (2), (3), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (17), (18), (19), (20), (21), (22), (23), (24), (25), (26), (27), (28), (29), (30), (31), (32), (33), (34), (35), (36), (37), (38), (39), (40), (41), (42), (43), (44), (45), (46), (47), (48), (49), (50), (51), (52), (53), (54), (55), (56), (57), (58), (59), (60), (61), (62), (63), (64), (65), (66), (67), (68), (69), (70), (71), (72), (73), (74), (75), (76), (77), (78), (79), (80), (81), (82), (83), (84), (85), (86), (87), (88), (89), (90), (91), (92), (93), (94), (95), (96), (97), (98), (99), (100), (101), (102), (103), (104), (105), (106), (107), (108), (109), (110), (111), (112), (113), (114), (115), (116), (117), (118), (119), (120), (121), (122), (123), (124), (125), (126), (127), (128), (129), (130), (131), (132), (133), (134), (135), (136), (137), (138), (139), (140), (141), 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(1000).

additional copies of these standards, contact: OSHA Office of Enforcement, U.S. Department of Labor, 200 Constitution Avenue, NW, DC 20210. Telephone (202) 219-1111.

[GPO: 5-23-1986]

FOR FURTHER INFORMATION CONTACT: Mr. James F. Foster, Director, Office of Information and Consumer Affairs, OSHA, U.S. Department of Labor, Room N-3637, 200 Constitution Avenue, NW, Washington, DC 20210. Telephone (202) 523-6151.

SUPPLEMENTARY INFORMATION

I. Introduction

A. The Format of This Document (the Preamble)

The preamble accompanying these revised standards is divided into 13 parts, numbered I through XIII. The following is a table of contents:

- I. Introduction
- II. Regulatory History
- III. Pertinent Legal Authority
- IV. Health Effects
- V. Quantitative Risk Assessment
- VI. Significance of Risk
- VII. Final Economic Impact, and Regulatory Feasibility Analysis
- VIII. Environmental Impact Assessment
- IX. Standards Recommended by OSHA by Interested Parties
- X. Summary and Explanation of the Revised Standard for General Industry
- XI. Summary and Explanation for a Revised Standard for the Construction Industry
- XII. Authority and Signature
- XIII. Amended Standards

References to the rulemaking record are in the text of the preamble, and the following abbreviations have been used:

number. (1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13) (14) (15) (16) (17) (18) (19) (20) (21) (22) (23) (24) (25) (26) (27) (28) (29) (30) (31) (32) (33) (34) (35) (36) (37) (38) (39) (40) (41) (42) (43) (44) (45) (46) (47) (48) (49) (50) (51) (52) (53) (54) (55) (56) (57) (58) (59) (60) (61) (62) (63) (64) (65) (66) (67) (68) (69) (70) (71) (72) (73) (74) (75) (76) (77) (78) (79) (80) (81) (82) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (98) (99) (100).

B. Summary

Pursuant to sections 4(b)(2), 8(b), 8(c), and 8(e) of the Occupational Safety and Health Act of 1970 (the Act) [84 Stat. 1562, 1563, 1566, 1569; 29 U.S.C. 653, 655, 657], the Construction Safety Act (40 U.S.C. 333), the Longshoremen's and Harbor Workers' Compensation Act (33 U.S.C. 941), the Secretary of Labor's Order No. 9-83 [48 FR 35736], and 29 CFR Part 1911, these final standards hereby amend and revise the current asbestos standard, 29 CFR 1910.1001.

This action follows publication of proposed notices on November 4, 1983 [48 FR 51085] and on April 10, 1984 [49 FR 14116] and the holding of a public hearing to provide the public with an opportunity to comment on these proposed revisions. The hearings were held from June 19 to July 10, 1984, in Washington, DC. More than 55,000 pages of testimony and comments were received into the record of this rulemaking and have been analyzed by the Agency in developing these final standards. Based on this record, OSHA has determined that employees exposed to asbestos, tremolite, anthophyllite, and actinolite at the existing permissible exposure limit (PEL) of 2 fibers per cubic centimeter of air (2 f/cc) at workplaces in the construction and maritime industries and in general industry workplaces face a significant risk to their health and that these final standards will substantially reduce that risk. Evidence in the record of this proceeding has shown that employees exposed at the revised standards' PEL of 0.2 fiber/cc remain at significant risk of incurring a chronic exposure-related disease, but considerations of feasibility have constrained OSHA to set the revised PEL at the 0.2 fiber/cc level.

The standard issued in 1971 defined asbestos as chrysotile, crocidolite, amosite, tremolite, anthophyllite, and actinolite. All of these minerals represent a hazard to workers, and the revised standard continues to regulate all of them. However, some forms of these minerals are no longer included in the definition of the word "asbestos". The regulatory text clearly specifies that the standards apply to occupational exposure to asbestos, tremolite, anthophyllite, and actinolite. In the preamble, however, where the word "asbestos" is used this should be interpreted as applying to tremolite, anthophyllite, and actinolite as well.

emissions, including work practices that must be followed to minimize the release of asbestos fibers during the handling of asbestos-containing materials.

average (TWA) and a peak exposure level of 10 f/cc.
In June 1972, OSHA promulgated a

separate proposal applicable to the construction industry, no such proposal was published.

In June 1972, OSHA promulgated a new final standard that established an 8-hour time-weighted average PEL of 5 f/cc and a ceiling limit of 10 f/cc. These limits were intended primarily to protect employees against asbestosis, and it was hoped that they would provide some incidental degree of protection against asbestos induced forms of cancer.

Michigan, Minnesota, Nevada, New Mexico, New York, North Carolina, Oregon, Puerto Rico, South Carolina, Tennessee, Utah, Vermont, Virginia, the Virgin Islands, Washington, and Wyoming. (In Connecticut and New York, the plan covers only State and local government employees.)

II. Regulatory History

OSHA has regulated asbestos since 1971. A 12 f/cc permissible exposure limit (PEL) for asbestos was included in the initial promulgation on May 29, 1971 (36 FR 10466) of OSHA standards pursuant to Section 8(a) of the Act. 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 as an 8-hour time-weighted

average to 0.5 f/cc and imposed a ceiling limit of 5 f/cc for 15 minutes.

The basis for the 1975 proposal's reduction in the permissible exposure limit to 0.5 f/cc was OSHA's then-current policy for carcinogens that assumed that no safe threshold level was demonstrable and therefore that the Act required the Agency to set the PEL at a level as low as technologically and economically feasible. This policy was rejected by the Supreme Court in the benzene decision (*JEV v. A.P.*, 448 U.S. 601 (1980)) (see the discussion of the implications of the benzene decision for OSHA rulemaking in the *Significance of Risk* section of the preamble, section VII). The 1975 proposal would have applied to all industries except construction. Further, although OSHA announced its intention to develop a

pursuant to notice and section 6(b) of the Act (29 U.S.C. 655(b)(3)). The hearings were presided over by Administrative Law Judge Robert G. Mahoney. Post-hearing submissions of data, comments, and briefs were received through November 1, 1984. The entire record, including over 340 exhibits and approximately 35,000 pages of material, was certified by Judge Mahoney on September 27, 1985, in accordance with 29 CFR 1911.17. Copies of materials contained in the record may be obtained from the OSHA Docket Office, Room N3870, U.S. Department of Labor, 200 Constitution Avenue, NW, Washington, DC 20210. These final standards on occupational exposure to asbestos in construction and general industry are based on a thorough consideration of the entire record of this

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ing materials
ed on in the November
84 notices, the record
esting, and all written
hibits received.

(a) Authority
urpose of the
ety and Health Act (29
j) (the Act) is to assure,
e, safe and healthful
ins for every American
period of his or her
One means prescribed
to achieve this goal is
to, and the
hority vested in, the

threshold findings. OSHA must find that
a significant risk exists under the
current standard and that the issuance
of a new standard would reduce or
eliminate that risk. The Court stated:

We agree . . . that subsection 3(g)
requires the Secretary to find, as a threshold
matter, that the toxic substance in question
poses a significant health risk in the
workplace and that a new, lower standard is
therefore "reasonably necessary or
appropriate to provide safe and healthful
employment and places of employment." 428
U.S. 607 at 614-15, 65 L. Ed. 2d 1010 at 1016-
19.

The Court also stated:

. . . Before he can promulgate any

might well consider the risk significant and
take appropriate steps to decrease or
eliminate it. (Id. at 651, 658 L. Ed. 2d at 1043.)

After OSHA has determined that a
significant risk exists and that such risk
can be reduced or eliminated by the
proposed standard, it must set the
standard "which most adequately
assures, to the extent feasible on the
basis of the best available evidence,
that no employees will suffer material
impairment of health . . ." (section
6(b)(5) of the Act). The Supreme Court
has interpreted this section to mean that
OSHA must enact the most protective
standard possible to eliminate a
significant risk of material health

OSHA is aware of no instance in which exposure to a toxic substance has more clearly demonstrated detrimental health effects on humans than has asbestos exposure. The diseases caused

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procedures, monitoring
of employee exposure,
to the results of
appropriate medical
and training and
over, where a standard
al examinations or
must be available at no
pyear (Section 6(b)(7)).
also prescribe
requirements where
appropriate for the
the Act or for developing
ing occupational
nesses (Section 3(c)).
SHA's revision to its
d, the Supreme Court
trial *Union*
C-*CIO v. American*
ite, 448 U.S. 601, 65 L.
S. Ct. 2844 (1980), that
nce of a new or revised
nt to section 6(b)(5) of
must make two

We recognize that its determination that a
particular level of risk is "significant" will be
based largely on policy considerations. (448
U.S. at 658, 65 L. Ed. 2d at 1040, n. 62)

Finally, the Court pointed out that
. . . OSHA is not required to support its
finding that a significant risk exists with
anything approaching scientific certainty.
Although the Agency's findings must be
supported by substantial evidence . . .
OSHA (has) some leeway where its findings
must be made on the frontiers of scientific
knowledge. (448 U.S. at 656, 65 L. Ed. 2d at
1043.)

In the only concrete example of
significance, the Court stated:
Some risks are plainly acceptable and
others are plainly unacceptable. If, for
example, the odds are one in a billion that a
person will die from cancer by taking a drink
of chlorinated water, the risk clearly could
not be considered significant. On the other
hand, if the odds are one in a thousand that
regular inhalation of gasoline vapors that are
2% benzene will be fatal, a reasonable person

threatening or disabling. Among these
diseases are lung cancer, cancer of the
mesothelial lining of the pleura and
peritoneum, osteosis, and
gastrointestinal cancer. Of all of the
diseases caused by asbestos, lung
cancer constitutes the greatest health
risk for American asbestos workers.
Lung cancer has been responsible for
more than half of the excess mortality
from asbestos exposure in some
occupational cohorts.

The relationship between lung cancer
and asbestos exposure has been
established in numerous epidemiologic
studies of diverse groups. Asbestos-
induced lung cancer usually has a
latency period in excess of 20 years, and
this cancer may be manifested at a
younger age than is true for lung cancer
victims who are not exposed to asbestos
(Creighton et al. Ex. 34-033). Few cases
of lung cancer are curable, despite
advances in medical and surgical

proceeding, including materials discussed or relied on in the November 1983 and April 1984 notices, the record of the informal hearing, and all written comments and exhibits received.

DE. Pertinent Legal Authority

The primary purpose of the Occupational Safety and Health Act (29 U.S.C. 651 et seq.) (the Act) is to assure, so far as possible, safe and healthful working conditions for every American worker over the period of his or her working lifetime. One means prescribed by the Congress to achieve this goal is the mandate given to, and the concomitant authority vested in, the Secretary of Labor to set mandatory safety and health standards. The Congress specifically mandated 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 a standard 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 standards, and experience gained under this and other health and safety laws. [Section 6(b)(5)]

When appropriate, OSHA standards are required to include provisions for labels or other appropriate forms of warning to apprise employees of hazards, suitable protective equipment, exposure control procedures, monitoring and measuring of employee exposure, employee access to the results of monitoring, appropriate medical examinations, and training and education. Moreover, where a standard prescribes medical examinations or other tests, they must be available at no cost to the employee [Section 6(b)(7)]. Standards may also prescribe recordkeeping requirements where necessary or appropriate for the enforcement of the Act or for developing information regarding occupational accidents and illnesses [Section 8(c)].

In vacating OSHA's revision to its benzene standard, the Supreme Court required in *Industrial Union Department, AFL-CIO v. American Petroleum Institute*, 448 U.S. 607, 65 L. Ed. 2d 1000, 100 S. Ct. 2844 (1980), that before the issuance of a new or revised standard pursuant to section 6(b)(5) of the Act, OSHA must make two

threshold findings. OSHA must find that a significant risk exists under the current standard and that the issuance of a new standard would reduce or eliminate that risk.

We agree . . . that requires the Secretary to find, that the toxic poses a significant risk in the workplace and that it therefore "reasonably" appropriate to provide employment and place U.S. 607 at 614-15, 65

19. The Court also state

. . . . But we do not mean to say that the Secretary of Labor is required to find that a hazard exists and can be eliminated by a change U.S. at 614, 65 L. Ed. 2d

The decision, although the uncertainties in that the determination "risk" should, if at all established on the basis of the best available such means as quantitative measurements. However, in determining the general guidance for that

. . . . The requirement that be identified is not sufficient. It is the duty to determine, in the first instance, to be a "significant risk" U.S. at 614, 65 L. Ed. 2d at

It pointed out the

. . . . Most support is level of risk exists by we recognize that the particular level of risk based largely on public U.S. at 614, 65 L. Ed. 2d

Finally, the Court

. . . . OSHA is not finding that a significant risk exists. Although the Agency suggested by section 6(b)(5) of the Act, OSHA (has) some risk must be made on the knowledge. (448 U.S. 1042)

In the only concrete example of significance, the Court stated:

Some risks are plainly acceptable and others are plainly unacceptable. If, for example, the odds are one in a billion that a person will die from cancer by taking a drink of chlorinated water, the risk clearly could not be considered significant. On the other hand, if the odds are one in a thousand that regular inhalation of gasoline vapors that are 2% benzene will be fatal, a reasonable person

might well consider the risk significant and take appropriate steps to decrease it eliminate it. (Id. at 614, 65 L. Ed. 2d at 1042.)

After OSHA has determined that a

IV. Health Effects

A. Overview of Asbestos-Related Diseases

OSHA is aware of no instance 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 exposure are life-threatening or disabling. Among these diseases are lung cancer, cancer of the mesothelial lining of the pleura and peritoneum, asbestosis, and gastrointestinal cancer. Of all of the

established in numerous epidemiologic studies of diverse groups. Asbestos-induced lung cancer usually has a latency period in excess of 20 years, and this cancer may be manifested at a younger age than is true for lung cancer victims who are not exposed to asbestos (Cesighead et al. Ex. 84-033). Few cases of lung cancers are curable, despite advances in medical and surgical

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of State, County and Municipal Employees. (AFSCME, Ex. 141); ORC, or assume it is asbestos (Ex. 145), SBA, limited to employers whose work duties involve contact with ACM shall assure that all ACM in workplace is identified, need not inspect building areas constructed since 1980.

2. Mandatory notification to OSHA by employers of all removal, renovation, and abatement work: Recommended by BCTD. (Ex. 143, Att. A at 3); The Courditch-Roberts Group. (L7-185); Gobeil Hays Partners, Inc. (7-149).

3. Mandatory use of negative pressure enclosures in regulated areas, except for small-scale, short-duration operations and other limited circumstances: Recommended by BCTD. (Ex. 143 Att. A

e.g., 8 for quantity cut-offs for SSSD activities.)

16. A clearance fiber level of 0.04 f/cc was recommended by SESAC who stated that such a requirement was needed to "ensure that the asbestos work area is safe to enter by unprotected personnel after the asbestos work operation is completed." (Ex. 7-77).

Relationship to Indoor Air Quality Proposed Rule

On April 5, 1994 at 59 FR 15968, OSHA proposed a new standard for indoor air quality. The proposed regulation included a clause making brief reference to asbestos. See Paragraph (d)(8) at page 16339. That reference was unintended as OSHA,

of the time (55 FR 29720). However, OSHA explained that PELs lower than 0.1 f/cc are difficult to reliably measure. However OSHA has followed a more effective approach to lowering exposures for those sections and operations where lower exposures can be achieved. This approach is triggering protective provisions based on the kind of operation undertaken, rather than measured exposure levels. This approach is consistent with some other health standards (e.g., lead, coke ovens).

A major reason for this approach for construction and shipyards is that measured levels of exposure often fail to define risk and are often not received before the work is completed. This was partly explained in the proposal. There

A significant risk remains at the PEL of 0.1 f/cc, and it is feasible to attain lower levels for some workers exposed to asbestos.

respond to acknowledge OSHA's role in building by establishing O&M plan. Recommended by SEIU (Ex. 144 at 17); AFSCME, (Ex. 141).

10. Change in medical surveillance requirements for maintenance and custodial workers in ACM buildings—they exceed the 90 day limit.

Recommended by AFSCME, (Ex. 141).

11. Reduce action level to 0.05 f/cc. Recommended by BCTD. (Ex. 143).

12. Reduce STEL to 0.5 f/cc over 30 minutes. Recommended by BCTD. (Ex. 143), also by SESAC and NIOSH (Ex. 7-77, 125).

13. Require most effective respirators feasible in all asbestos work.

Recommended by BCTD. (Ex. 143).

14. Require more specific and protective brake repair procedures. Recommended by Clayton Associates, Inc. (Ex. 148).

15. Regulate activities involving "friable" asbestos-containing material differently from those involving "non-friable" asbestos. Recommended by Edison Electric Institute, (Ex. 7-145, at

14-15). OSHA has made these changes in response to the request for extension of reporting and information transfer requirements; the expansion of the competent person requirement to all employers engaged in any kind of construction work; and, the clarification of the small scale, short duration operation exemption from the requirement to establish a negative-pressure enclosure. For convenience OSHA is summarizing here its response to each of these issues. They are discussed below in the other changes OSHA has made which are not in direct response to the request.

Issue 7. Establishment of Operation Specific Exposure Limits: The court remand causes OSHA to consider establishing operation-specific permissible exposure limits to the extent feasible, as needed to eliminate significant risk of illnesses caused by asbestos exposure. OSHA proposed to decrease the PEL to a uniform 0.1 f/cc. OSHA believes that this limit is feasible for most industry sectors to reach most

different tasks for different operations based on the lowest exposure limits that can feasibly be achieved in those operations and that are needed to eliminate significant risk. OSHA has decided not to do so because the operation-specific work practices mandated in the standard will be a most cost-effective means of ensuring that significant risk is eliminated to the extent feasible.

Asbestos has been the subject of extensive rulemaking by OSHA and other agencies, and the operations that expose employees to asbestos are well known and thoroughly studied. Moreover, given the shift away from asbestos products wherever substitutes are available, it appears unlikely that major new uses will be found for asbestos in the future. OSHA has therefore been able to focus its rulemaking effort on evaluating the work practices that will best reduce asbestos exposure in the specific operations that expose workers to asbestos. The result is a standard that

exposures hold lower risk than the Agency estimates * * * we do not believe that the risk assessment that is six years old relies on the best available evidence." AIANA requested OSHA to

cannot answer * * * with certainty * * * if "one fiber * * * of amphibole (is) more dangerous than one fiber * * * of chrysotile." (ibid.).

Second, as stated in the 1986 asbestos

mortality, because of the relatively short follow up period used (51 FR 22618).

Other studies involved lung burden analyses of mesothelioma victims,

consistently showing that the asbestos

After a comprehensive review of the evidence submitted concerning the validity of the 1984 risk assessment, OSHA has determined that it will continue to rely on the earlier analysis. The Agency believes that the studies used to derive risk estimates remain valid and reliable, and that OSHA's decision to not separate fiber types for purposes of risk analysis is neither scientifically nor regulatorily incorrect.

mesothelioma than is exposure to chrysotile * * * No clear risk differential for lung cancer or other asbestos-related disease has been demonstrated by epidemiological studies. Animal experiments, however, have indicated that chrysotile is a more potent carcinogen than amphiboles when administered by inhalation or intrapleural injection * * * (51 FR at 22620).

OSHA agreed with the testimony of Dr. Davis, who stated that "the evidence

EPA, consisting of numerous studies and reports. Some of these documents were considered by OSHA in the prior rulemaking. There, OSHA had stated that the 1983 Berry and Newhouse study of friction materials manufacturing workers which found nonsignificant increases in lung cancer mortality, was inconsistent with other studies showing that low level asbestos exposure resulted in excess lung cancer

136, 125, ARL 5, 143 ARL C, 143 ARL D). In support of the opposing claim that chrysotile has reduced carcinogenic potential, AIANA and SBA submitted additional evidence. For example, AIANA submitted the World Health Organization's 1989 working report which recommended that the exposure limit for chrysotile should be reduced to 1 f/cc or below (8 hour TWA), where it was recommended that exposure to

exposures hold lower risk than the Agency estimates . . . we do not believe that the risk assessment that is six years old relies on the best available evidence." ALANA requested OSHA to convene experts, as part of this hearing process, "to revise its asbestos risk

cannot answer . . . with certainty . . . if "one fiber . . . of amphibole (is) more dangerous than one fiber . . . of chrysotile." (ibid.).

Second, as stated in the 1986 asbestos standard, even if OSHA were to accept the premise (which it does not) that

mortality, because of the relatively short follow up period used (51 FR 22618).

Other studies involved lung burden analyses of mesothelioma victims, apparently showing that the pulmonary content of chrysotile was within the range of the mesothelioma victims.

Second, as stated in the 1986 asbestos standard, even if OSHA were to accept the premise (which it does not), that chrysotile may present a lower cancer risk than other asbestos fiber types, occupational exposure to chrysotile asbestos still presents a significant risk of disease at the revised PEL

associated with a greater risk of mesothelioma than is exposure to chrysotile . . . No clear risk differential for lung cancer or other asbestos-related disease has been demonstrated by epidemiological studies. Animal experiments, however, have indicated that chrysotile is a more potent carcinogen than amphiboles when administered by inhalation or intrapleural injection. . . . (51 FR at 22620).

OSHA agreed with the testimony of Dr. Davis, who stated that "the evidence

appended its 1989 submission to the EPA, consisting of numerous studies and reports. Some of these documents were considered by OSHA in the prior rulemaking. There, OSHA had stated that the 1983 Berry and Newhouse study of friction materials manufacturing workers which found "nonsignificant increases in lung cancer mortality, was inconsistent with other studies showing that low level asbestos exposure resulted in excess lung cancer

chrysotile asbestos [see Ex. 315 C, 1-136, 125, Art. 5, 143 Art. C, 143 Art. D]. In support of the opposing claim that chrysotile has reduced carcinogenic potential, ALANA and SBA submitted additional evidence. For example, ALANA submitted the World Health Organization's 1989 working report which recommended that the exposure limit for chrysotile should be reduced to 1 f/cc or below (8 hour TWA), where it was recommended that exposure to

exposures hold lower risk than the Agency estimates . . . we do not believe that the risk assessment that is six years old relies on the best available evidence." AIANA requested OSHA to convene experts, as part of this hearing process "to revise its asbestos risk assessment." [Tr. 530]. This was the major objection to OSHA's earlier risk assessment. Some participants voiced similar objections. (Ex. 7-80, 7-110, 7-104, 7-120, Ex. 145, 151), while others were of the opinion that chrysotile had the same potency as other forms of asbestos (see Ex. 119 C, 1-135, 125, At.

cannot answer . . . with certainty . . . if "one fiber . . . of amphibole (is) more dangerous than one fiber . . . of chrysotile." [ibid].

Second, as stated in the 1986 asbestos standard, even if OSHA were to accept the premise (which it does not), that chrysotile may present a lower cancer risk than other asbestos fiber types, occupational exposure to chrysotile asbestos still presents a significant risk of disease at the revised PEL. (See 51 FR 22649, 22652). In particular, asbestosis, the disabling and often fatal fibrosis of the deep portions of the lung, is caused

mortality, because of the relatively short follow up period used (51 FR 22618).

Other studies involved lung burden analyses of mesothelioma victims, apparently showing that the pulmonary content of chrysotile was within the range of the general population, whereas amphibole content was significantly elevated compared to the general population (see e.g. Churg, Malignant Mesothelioma in British Columbia in 1982, Cancer, 2/83, 672). OSHA noted in the preamble to the 1986 rule, that there is a difference in tissue retention which would account for the autopsy

Some new evidence on the issue of differential risks of asbestos fiber types was submitted by both supporters and detractors of that theory.

with regard to lung cancer and asbestosis. The evidence submitted in support of the claim that chrysotile asbestos is less toxic than other asbestos fiber types is related primarily to mesothelioma. This evidence is unpersuasive, and it provides an insufficient basis upon which to regulate that fiber type less stringently. As OSHA explained in the preamble to the 1986 standards,

. . . "to summarize the data on risk differential by asbestos fiber type. Human epidemiological studies have suggested that occupational exposure to amphibole is associated with a greater risk of mesothelioma than is exposure to chrysotile . . . No clear risk differential for lung cancer or other asbestos-related disease has been demonstrated by epidemiological studies. Animal experiments, however, have indicated that chrysotile is a more potent carcinogen than amphiboles when administered by inhalation or intrapleural injection . . ." (51 FR at 22620).

OSHA agreed with the testimony of Dr. Davis, who stated that "the evidence

exposures to different fiber types. Thus, regulating different fiber types at differing levels, would require more monitoring all the time and would produce limited benefits (51 FR 22682).

Consequently, OSHA believes that its conclusion to treat all asbestos fibers as having a similar potency in the occupational setting remains valid. Most of the evidence submitted to the remand rulemaking duplicated evidence submitted to the 1986 standards' record, or was cumulative to the earlier body of evidence. For example AIANA appended its 1988 submission to the EPA, consisting of numerous studies and reports. Some of these documents were considered by OSHA in the prior rulemaking. There, OSHA had stated that the 1983 Berry and Newhouse study of friction materials manufacturing workers which found "nonsignificant increases in lung cancer mortality, was inconsistent with other studies showing that low level asbestos exposure resulted in excess lung cancer

the same pulmonary symptoms in the evidence submitted by proponents of differential regulation of fiber types, and had rejected the claim that chrysotile should be regulated less stringently.

Some new evidence on the issue of differential risks of asbestos fiber types was submitted by both supporters and detractors of that theory.

In support of the position that chrysotile asbestos exposure is equivalent in risk to amphibole asbestos exposure, BCID submitted studies which indicated excess mesothelioma cases in workers exposed solely to chrysotile asbestos (see Ex. 115 C, 1-135, 125, At. 5, 143 At. C, 143 At. D), in support of the opposing claim that chrysotile has reduced carcinogenic potential, AIANA and SBA submitted additional evidence. For example, AIANA submitted the World Health Organization's 1989 working report which recommended that the exposure limit for chrysotile should be reduced to 1 f/cc or below (8 hour TWA), where it was recommended that exposure to

Among the studies submitted in support of the lowered risk of chrysotile asbestos, are those of Churg, and others showing that the lung burden of mesothelioma victims is predominantly amphibole, even though high chrysotile exposure levels were reported. As noted above, this line of argument was presented in the earlier asbestos rulemaking, and OSHA had concluded that lung burden studies are inconclusive.

knowledge (Fr. 1074) there is recent evidence that chrysotile is "the most effective of the three major fiber types at migrating to the pleura, that it is present in substantial amounts in pleural plaques and mesotheliomas,

asbestos risks because it treated the risks from all asbestos fiber types equally. other contentions were made that the earlier risk assessment may have understated the risks from asbestos, because it ignored evidence of the

studies described by an OSHA rulemaking docket include: a study of 666 New York school custodians, reporting only x-ray data (Ex. 47). For all groups of workers, the lung abnormality seen on x-ray was associated with duration of

exposures hold lower risk than the Agency estimates . . . we do not believe that the risk assessment that is six years old relies on the best available evidence." ALANA requested OSHA to convene experts, as part of this hearing process "to revise its asbestos risk assessment." (Tr. 530), this was the major objection to OSHA's earlier risk assessment. Some participants voiced similar objections. (Ex. 7-80, 7-110, 7-104, 7-120, Ex. 145, 151), while others were of the opinion that chrysotile had the same potency as other forms of asbestos (see Ex. 119 C, 1-135, 125, Att. 8, 143 Att C, 143 Att. D.).

Although as noted above, the issue of the continuing validity of OSHA's

cannot answer . . . with certainty . . . if "one fiber . . . of amphibole (is) more dangerous than one fiber . . . of chrysotile." (ibid.).

Second, as stated in the 1986 asbestos standard, even if OSHA were to accept the premise (which it does not), that chrysotile may present a lower cancer risk than other asbestos fiber types, occupational exposure to chrysotile asbestos still presents a significant risk of disease at the revised PEL (See 51 FR 22549, 22552). In particular, asbestosis, the disabling and often fatal fibrosis of the deep portions of the lung, is caused by exposure to all types of asbestos. The evidence on this is strong and no new information has been presented to

mortality, because of the relatively short follow up period used (51 FR 22618).

Other studies involved lung burden analyses of mesothelioma victims, apparently showing that the pulmonary content of chrysotile was within the range of the general population, whereas amphibole content was significantly elevated compared to the general population (see e.g. Churg, Malignant Mesothelioma in British Columbia in 1982, Cancer, 2/83, 672). OSHA noted in the preamble to the 1986 rule, that there is a difference in tissue retention which would account for the autopsy results and cited a study by Glysoth et al. (Doc. 33-C, Ex. 312) which supported that explanation. OSHA also

OSHA believes that its conclusion to treat all asbestos fibers as having a similar potency in the occupational setting remains valid.

fiber types is related primarily to mesothelioma. This evidence is unpersuasive, and it provides an insufficient basis upon which to regulate that fiber type less stringently. As OSHA explained in the preamble to the 1986 standards,

. . . to summarize the data on risk differential by asbestos fiber type. Human epidemiological studies have suggested that occupational exposure to amphibole is associated with a greater risk of mesothelioma than is exposure to chrysotile . . . No clear risk differential for lung cancer or other asbestos-related disease has been demonstrated by epidemiological studies. Animal experiments, however, have indicated that chrysotile is a more potent carcinogen than amphiboles when administered by inhalation or intrapleural injection . . . (51 FR at 22620).

OSHA agreed with the testimony of Dr. Davis, who stated that "the evidence

producing limited benefits (51 FR 22682).

Consequently, OSHA believes that its conclusion to treat all asbestos fibers as having a similar potency in the occupational setting remains valid. Most of the evidence submitted to the remand rulemaking duplicated evidence submitted to the 1986 standards' record, or was cumulative to the earlier body of evidence. For example ALANA appended its 1988 submission to the EPA, consisting of numerous studies and reports. Some of these documents were considered by OSHA in the prior rulemaking. There, OSHA had stated that the 1983 Berry and Newhouse study of friction materials manufacturing workers which found nonsignificant increases in lung cancer mortality, was inconsistent with other studies showing that low level asbestos exposure resulted in excess lung cancer

mortality (51 FR 22682).

Some new evidence on the issue of differential risks of asbestos fiber types was submitted by both supporters and detractors of that theory.

In support of the position that chrysotile asbestos exposure is equivalent in risk to amphibole asbestos exposure, BCTD submitted studies which indicated excess mesothelioma cases in workers exposed solely to chrysotile asbestos (see Ex. 115 C, 1-136, 125, Att. 8, 143 Att C, 143 Att. D), in support of the opposing claim that chrysotile has reduced carcinogenic potential, ALANA and SBA submitted additional evidence. For example, ALANA submitted the World Health Organization's 1989 working report which recommended that the exposure limit for chrysotile should be reduced to 1 f/cc or below (8 hour TWA), where it was recommended that exposure to



February 29, 2008

Federal Register

Part IV

Department of Labor

Mine Safety and Health Administration

30 CFR Parts 56, 57, and 71

Asbestos Exposure Limit; Final Rule

PLAINTIFF EXHIBIT

SOA 5865

**Exhibit
316**

DEPARTMENT OF LABOR

Mine Safety and Health Administration

008/Rules and Regulations

(c) asbestos standard (29 CFR 1910.1001). Appendix A specifies basic elements of a phase contrast microscopy (PCM) method for analyzing airborne asbestos samples, which includes the same basic analytical elements as those specified in MSHA's existing standards.

Because the risk assessment used as the basis for MSHA's asbestos PELs relies on PCM-based methodology, MSHA will continue to use PCM as the primary methodology for analyzing air samples to determine compliance with the PELs. PCM provides a relatively quick and cost-effective analysis of asbestos samples. In addition, MSHA will continue to follow-up with its policy of using a transmission electron microscopy (TEM) analysis when PCM results indicate a potential overexposure.

ACTION: Final rule.

Asbestos Exposure Limit

C. Alternatives Considered

D. Regulatory Flexibility Analysis (RFA) for SBREFA) tions a Method amble

underground coal mines. This final rule reduces the permissible exposure limits for airborne asbestos fibers and makes clarifying changes to the existing

permissible exposure limits (PELs) for asbestos; incorporates the Occupational Safety and Health Administration (OSHA) Reference Method (29 CFR

Although OSHA stated in the preamble to its 1994 final rule (59 FR 40967) that there is a remaining significant risk of material impairment of health or functional capacity at the 0.1 f/cc limit, OSHA concluded that this concentration is "the practical lower limit of feasibility for measuring asbestos levels reliably." MSHA agrees with this conclusion.

Permissible Exposure Limits (PELs)

a reference to Appendix A of OSHA's

and were contemplated in the proposed

rule and, therefore, are beyond the scope of this final rule.

B. Mineralogy and Analytical Methods for Asbestos

century among workers involved in the manufacturing or use of asbestos-containing products.⁸ These studies identified the inhalation of asbestos as the cause of asbestosis, a slowly

and those involving miners. One such review by Tweeddale (2002) stated,

Asbestos has become the leading cause of occupational related cancer death, and the second most fatal manufactured carcinogen

A

search of peer-reviewed scientific literature yielded many new articles¹⁵ that continue to demonstrate and support findings of asbestos-induced lung cancer, mesotheliomas, and asbestosis, consistent with the conclusions of OSHA and ATSDR. Thus, in the scientific community, there is compelling evidence of the adverse health effects of asbestos exposure.

⁸ www.epa.gov/iris/susbst/0371.htm.

⁹ Asbestos mineralogy was discussed more fully in the proposed rule (70 FR 43952-43953).

¹⁰ U.S. Bureau of Mines (Campbell *et al.*), 1977.

¹¹ Mesker *et al.*, 2003.

¹² Rudd, 2005.

¹³ Bolton *et al.*, 2002; OSHA, 1986.

¹⁴ ATSDR, 2001; Manning *et al.*, 2002.

¹⁵ ATSDR, 2001; Peacock *et al.*, 2000; Grighood *et al.*, 1982.

¹⁶ Baron, 2001; Bolton *et al.*, 2002; Manning *et al.*, 2002; Nicholson, 2001; Osinubi *et al.*, 2000; Roach *et al.*, 2002.

¹⁷ ICRP, 1966; EPA, 1986; West, 2000 and 2003; Manning *et al.*, 2002.

On March 29, 2002 (67 FR 15134), MSHA published an advance notice of proposed rulemaking to obtain public

comment on asbestos in sedimentary rock. The U.S. Geological Survey (USGS) has reported weathering or abrasion of asbestos-

contaminant in others. The USGS estimates that, during 2006, manufacturers in the United States used

III. Asbestos Exposures in Mines

A. Where Asbestos Is Found at Mines

Asbestos exposure of miners can come from either naturally occurring asbestos in the ore or host rock or from asbestos contained in manufactured products.

1. Metal and Nonmetal Mines

The National Institute for Occupational Safety and Health (NIOSH) and other research organizations and scientists have noted the occurrence of cancers and asbestosis among miners involved in the mining and milling of commodities that contain asbestos.²⁴ (See Table IV-3.) Although asbestos is no longer mined as a commodity in the United States, veins,

of their process stream and final product.²⁵

2. Coal Mines

MSHA is aware of only one coal formation in the United States that contains naturally occurring asbestos; however, there is no coal mining in this formation.²⁶ The more likely exposure to asbestos in coal mining occurs at surface operations from introduced asbestos-containing materials (ACM).

personal air-sampling pump and a filter-cassette assembly. This assembly is composed of a 50-mm static-reducing, electrically conductive, extension cowl and a 0.8 µm pore size, 25-mm diameter, mixed cellulose ester (MCE) filter. Following standard sampling procedures, MSHA also submits blank filters for analysis.

MSHA collects a sample over the entire time the miner works; 10- to 12-hour shifts are common. The time-

3. Asbestos-Containing Materials (ACM)

²⁴ 727 F.2d 415, 1984.

²⁵ OSHA added specific provisions in the construction standard to cover unique hazards relating to asbestos abatement and demolition jobs.

²⁶ NIOSH World, 2003.

²⁷ MSHA (Bank), 1990; Ross, 1979.

²⁸ Meaker et al., 2003.

²⁹ MSHA (Bank), 1990; Amundus et al., Part 1, 1997.

³⁰ GETT Report, pp. 17-18, 2003; Nolan et al., 1990.

³¹ Brownfield et al., 1995.

³² MSHA to Compare a miner's exposure

³³ USGS (Vivian), 2007.

³⁴ GETT Report, pp. 12 and 15, 2003.

³⁵ Lemmon, 2003; Paustensch et al., 2003.

³⁶ EPA, 1989; EPA, 1983; EPA, October 2003.

On March 29, 2007, MSHA published proposed rulemaking comment on how from exposure to published the proposed 2005 (70 FR 43950) hearings in October.

F. OSHA's Asbestos

Like MSHA's, OSHA's PEL for occupational asbestos dropped in the past several decades.

Year	8-hr PEL
1971	12 f/cc
1971	5 f/cc
1972	2 f/cc
1983	0.5 f/cc
1988	0.2 f/cc
1994	0.1 f/cc

In addition, on September 1, 2007, OSHA promulgated an excursion limit of 30 minutes. OSHA's 1986 standard for occupational exposure to asbestos, amphibole, actinolite, tremolite, and anthophyllite. On June 8, 1992, OSHA removed asbestos from the scope of its standard (57 FR 24310).

III. Asbestos Exposure

A. Where Asbestos Is Found at Mines

Asbestos exposure of miners can come from either naturally occurring asbestos in the ore or from asbestos-containing products.

1. Metal and Nonmetal Mines

The National Institute for Occupational Safety and Health (NIOSH) and other organizations and studies have documented the occurrence of cancer among miners involved in the extraction and milling of commercial asbestos.²⁸ (See Table 1.) Asbestos is no longer a commodity in the United States; veins, pockets, or intrusions of asbestos-containing minerals have been found in other ores in specific geographic regions, primarily in metamorphic or igneous rock.²⁹ It is possible to find

²⁸ U.S. Court of Appeals for the 9th Circuit invalidated this rule on March 7, 1994, in *Asbestos Information Association/North America v. OSHA* (727 F.2d 415, 1984).

²⁹ OSHA added specific provisions in the construction standard to cover unique hazards relating to asbestos abatement and demolition jobs.

³⁰ NIOSH World, 2003.

³¹ MSHA (Bank), 1990; Ross, 1978.

effort to avoid deposits that are likely to contain asbestos minerals. They use knowledge of the geology of the area, maps, or bulk sample analysis and

B. Sampling Data and Exposure Calculations

To evaluate asbestos exposures in

Asbestos in manufactured products, such as electrical insulation, joint and packing compounds, automotive clutch and brake linings,³⁷ and fireproof protective clothing and welding blankets, could present a hazard during activities at the mine site that may cause a release of fibers.³⁸

The presence of asbestos at a mine indicates that there is a potential for exposure.

asbestos-containing materials (ACM).

3. Asbestos-Containing Materials (ACM)

Asbestos is a component in some commercial products and may be found

³² USGS, 1995.

³³ Roggli *et al.*, 2002; Selden *et al.*, 2001; Amandus *et al.*, Part I, 1987; Amandus *et al.*, Part III, 1987; Amandus and Wheeler, Part II, 1987; Meeker *et al.*, 2003.

³⁴ MSHA (Bank), 1990; Amandus *et al.*, Part I, 1987.

³⁵ GETF Report, pp. 17-18, 2003; Nolan *et al.*, 1999.

³⁶ Brownfield *et al.*, 1985.

hour shifts are common. The time-weighted average (TWA) PELs in MSHA's standards, however, are based on an 8-hour workday. Regardless of the actual shift length, MSHA calculates a full-shift concentration as if the fibers had been collected over an 8-hour shift. For work schedules less than or greater than 8 hours, this technique allows MSHA to compare a miner's exposure

³⁷ USGS (Virta), 2007.

³⁸ GETF Report, pp. 12 and 15, 2003.

³⁹ Lennan, 2003; Paustenbach *et al.*, 2003.

⁴⁰ EPA, 1986; EPA, 1993; EPA, October 2003.

The USGS has published a series of maps showing historic asbestos prospects and natural asbestos occurrences in the United States. USGS published a map covering the eastern states in 2005; the central states in 2006; and the Rocky Mountain states in 2007. These maps served as a guide for the investigation of possible naturally occurring asbestos within the vicinity of mining operations. MSHA found that stone mines and quarries are the predominate types of mining operations in the vicinity of naturally occurring asbestos locations identified on the maps. MSHA conducted field sampling at these mines to screen for potential asbestos exposures. The results of the sampling indicated a degree of asbestos at some of these mining operations, but no widespread asbestos contamination. Although included on the USGS maps, MSHA also surveyed two mines in El Dorado County, California. Sampling at one of the mines resulted in two persons with asbestos exposures greater than OSHA's PEL confirmed by TBM analysis, and 1 percent naturally occurring asbestos in an associated bulk sample. Air sampling at the other mine had low PCM filter results.

D. Asbestos Take-Home Contamination

The final rule, like the proposed rule, does not address take-home contamination. In making this decision, MSHA considered its enforcement experience; comments and testimony on the proposal; as well as OSHA, NIOSH, and EPA publications and experience.³⁹ MSHA based its determination to address asbestos take-home

MSHA has determined that OSHA's 1986 asbestos risk assessment (51 FR 22644) is applicable to asbestos exposures in mining. In developing this final rule, MSHA also evaluated studies published since OSHA completed its 1986 risk assessment, and studies that specifically focused on asbestos exposures of miners. These additional studies corroborate OSHA's conclusions in its risk assessment.

to prevent asbestos take-home contamination.

Commenters urged MSHA to expand the rulemaking to include specific requirements to prevent take-home contamination. NIOSH also encouraged MSHA to adopt measures included in

regulatory studies. MSHA's determination is true regardless of the type of cancer, e.g., lung, pleural or peritoneal mesotheliomas, or gastrointestinal. Although excess relative risk is linear in dose, the excess mortality rates in Table IV-1 are not.⁴⁰

TABLE IV-1.—ESTIMATED ASBESTOS-RELATED CANCER MORTALITY PER 100,000 BY NUMBER OF YEARS EXPOSED AND EXPOSURE LEVEL

Asbestos fiber concentration (f/cc)	Cancer mortality per 100,000 exposed			
	Lung	Mesothelioma	Gastro-intestinal	Total
1-year exposure				
0.1	7.2	6.9	0.7	14.8
0.2	14.4	13.8	1.4	29.6
0.5	36.1	34.6	3.6	74.3
2.0	144	138	14.4	296.4
4.0	288	275	28.8	591.8
5.0	360	344	36.0	740.0
10.0	715	684	71.5	1,470.5
20-year exposure				
0.1	139	73	13.9	225.9
0.2	278	146	27.8	451.8
0.5	692	362	69.2	1,123.2
2.0	2,713	1,408	271.3	4,392.3
4.0	5,278	2,706	527.8	8,511.8

³⁹ NIOSH (Report to Congress) September 1995.

⁴⁰ Nicholson, p. 53, 1983.

The USGS has published a series of maps showing historic asbestos prospects and natural asbestos occurrences in the United States. The USGS published a map covering the eastern states in 2005; the central states in 2006; and the Rocky Mountain states in 2007. These maps served as a guide for the investigation of possible naturally occurring asbestos within the vicinity of mining operations. MSHA found that stone mines and quarries are the predominate types of mining operations in the vicinity of naturally occurring asbestos locations identified on the maps. MSHA conducted fiber sampling at these mines to screen for potential asbestos exposures. The results of the sampling indicated degree of asbestos at some of the mining operations, but no wide asbestos contamination. Although included on the USGS maps, MSHA also surveyed two mines in El Dorado County, California. Sampling at the mines resulted in two persons with asbestos exposures greater than confirmed by TBM analysis, and one person with naturally occurring asbestos at an associated bulk sample. Air at the other mine had low PCM results.

D. Asbestos Take-Home Contamination

The final rule, like the proposed rule, does not address take-home contamination. In making this decision, MSHA considered its enforcement experience, comments and testimony on the proposal; as well as OSHA, NIOSH, and EPA publications and experience. MSHA based its determination to address asbestos take-home

contamination, without promulgating new regulatory provisions, on the following factors:

- There are no asbestos mines or mills currently operating in this country and different ore bodies of the same commodity, such as vermiculite mining, are not consistent in the presence, amount, or dispersion of asbestiform minerals. Based on MSHA's recent enforcement sampling, asbestos exposures in mining are low. (See Table III-1.)

- The measures taken to prevent take-home contamination are varied. Operators may choose the most effective method for eliminating this hazard.

its 1995 Report to Congress on their *Workers' Home Contamination Study Conducted under the Workers' Family Protection Act*. Other commenters, however, supported MSHA's decision and stated that take-home contamination requirements could not be justified at this time.

IV. Application of OSHA's Risk Assessment to Mining

MSHA has determined that OSHA's 1986 asbestos risk assessment (51 FR 22644) is applicable to asbestos exposures in mining. In developing this final rule, MSHA also evaluated studies

1. Cancer Mortality

In its 1986 risk assessment, OSHA estimated cancer mortality for workers exposed to asbestos at various cumulative exposures (i.e., combining exposure concentration and duration of exposure). MSHA has reproduced this data in Table IV-1. Table IV-1 shows that the estimated mortality from asbestos-related cancer decreases significantly by lowering exposure. This is true regardless of the type of cancer, e.g., lung, pleural or peritoneal mesotheliomas, or gastrointestinal.

TABLE IV-1.—ESTIMATED ASBESTOS-RELATED CANCER MORTALITY

Asbestos fiber	
0.1	139
0.2	278
0.5	692
2.0	2,713
4.0	5,278
10.0	

0.1	139	73	13.9	225.9
0.2	278	146	27.8	451.8
0.5	692	362	69.2	1,123.2
2.0	2,713	1,408	271.3	4,392.3
4.0	5,278	2,706	527.8	8,511.8

³⁹ NIOSH (Report to Congress) September 1995.

⁴⁰ Nicholson, p. 53, 1983.

The USGS has published a series of maps showing historic asbestos prospects and natural asbestos occurrences in the United States. The USGS published a map covering the eastern states in 2005; the central states in 2006; and the Rocky Mountain states in 2007. These maps served as a guide for the investigation of possible naturally occurring asbestos within the

contamination, without promulgating new regulatory provisions, on the following factors:

- There are no asbestos mines or mills currently operating in this country and different ore bodies of the same commodity, such as vermiculite mining, are not consistent in the presence, amount, or dispersion of asbestiform minerals. Based on MSHA's recent

its 1995 Report to Congress on their *Workers' Home Contamination Study Conducted under the Workers' Family Protection Act*. Other commenters, however, supported MSHA's decision and stated that take-home contamination requirements could not be justified at this time.

IV. Application of OSHA's Risk

TABLE IV-1.—ESTIMATED ASBESTOS-RELATED CANCER MORTALITY PER 100,000 BY NUMBER OF YEARS EXPOSED AND EXPOSURE LEVEL

Asbestos fiber concentration (f/cc)	Cancer mortality per 100,000 exposed			
	Lung	Mesothelioma	Gastro-intestinal	Total
1-year exposure				
0.1	7.2	6.9	0.7	14.8
0.2	14.4	13.8	1.4	29.6
0.5	36.1	34.6	3.6	74.3
2.0	144	138	14.4	296.4
4.0	288	275	28.8	591.8
5.0	360	344	36.0	740.0
10.0	715	684	71.5	1,470.5
20-year exposure				
0.1	139	73	13.9	225.9
0.2	278	146	27.8	451.8
0.5	692	362	69.2	1,123.2
2.0	2,713	1,408	271.3	4,392.3
4.0	5,278	2,706	527.8	8,511.8

³⁰ NIOSH (Report to Congress) September 1995.

⁴⁰ Nicholson, p. 53, 1983.

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contamination, without promulgating new regulatory provisions, on the following factors:

- There are no asbestos mines or mills currently operating in this country and different ore bodies of the same commodity, such as vermiculite mining, are not consistent in the presence, amount, or dispersion of asbestosiform

its 1995 Report to Congress on their *Workers' Home Contamination Study Conducted under the Workers' Family Protection Act*. Other commenters, however, supported MSHA's decision and stated that take-home contamination requirements could not be justified at this time.

TABLE IV-1.—ESTIMATED ASBESTOS-RELATED CANCER MORTALITY PER 100,000 BY NUMBER OF YEARS EXPOSED AND EXPOSURE LEVEL

Asbestos fiber concentration (f/cc)

Cancer mortality per 100,000 exposed

1-year exposure

0.1

6.9

	Lung	Mesothelioma	Cancer intestinal	Total
0.1	7.2		0.7	14.8
0.5	14.4		1.4	29.6
2.0	36.1	34.6	3.6	74.3
4.0	144	138	14.4	296.4
5.0	288	275	28.8	591.8
10.0	360	344	36.0	740.0
		684	71.5	1,470.5

20-year exposure

0.1

73

	Lung	Mesothelioma	Cancer intestinal	Total
0.1	139		13.9	225.9
0.2	278		27.8	451.8
0.5	692		69.2	1,123.2
2.0	2,713	1,408	271.3	4,392.3
4.0	5,278	2,706	527.8	8,511.8

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³⁹NIOSH (Report to Congress) September 1995.

⁴⁰Nicholson, p. 53, 1983.

Canadian miners and millers, Chrysotile

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Canadian miners and millers, Chrysotile

any risk assessment, including consideration of the potential for other diseases that may be related to the exposure to asbestos fibers.

Canadian miners and millers, Chrysotile

Canadian miners and millers, Chrysotile

Italian miners, Chrysotile

Italian miners, Chrysotile

Canadian miners and millers, Chrysotile

Indian miners and millers, Chrysotile

Canadian miners and millers, Chrysotile

Canadian miners and millers, Chrysotile

Indian miners and millers, Chrysotile and tremolite.

Brazilian miners and millers, Chrysotile

Canadian miners and millers, Chrysotile,

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s preventable by re-
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effects of asbestos exposure. MSHA recognizes that there are uncertainties in any risk assessment. MSHA concluded, however, that these studies provide further support of the significant risk of adverse health effects following exposure to asbestos.

MSHA reviewed the mining studies described in OSHA's asbestos risk assessment, as well as other studies that involved the exposure of miners to asbestos. Most of these studies were conducted in Canada, although some have been conducted in Australia, India,

Italy, South Africa, and the United States. Table IV-3 lists some of these mining studies, in chronological order, and gives the salient features of each study. These studies are in MSHA's rulemaking docket.

TABLE IV.-3—SELECTED STUDIES INVOLVING MINERS EXPOSED TO ASBESTOS

Author(s), year of publication	Study group, type of asbestos	Major finding(s) or conclusion(s)
Rossiter <i>et al.</i> , 1972	Canadian miners and millers, Chrysotile	Radiographic changes (opacities) related to age and exposure.
Becklake, 1979	Canadian miners and millers, Chrysotile	Weak relationship between exposure and disease.
Gibbs and du Toit, 1979	Canadian and South African miners, Chrysotile	Need for workplace epidemiologic surveillance and environmental programs.
Inwig <i>et al.</i> , 1979	South African miners, Amosite and Crocidolite	Parenchymal radiographic abnormalities preventable by re-

MSHA concludes that exposure to asbestos, a known human carcinogen, results in similar disease endpoints regardless of the occupation that has been studied.

Nayebzadeh <i>et al.</i> , 2001	Canadian miners and millers, Chrysotile	Respiratory disease related to regional differences in fiber concentration and not dimension.
Ramanathan and Subramanian, 2001	Indian miners and millers, Chrysotile and tremolite	Increased risk of cancer, restrictive lung disease, radiologic changes, and breathing difficulties; more common in milling.
Bagatin <i>et al.</i> , 2005	Brazilian miners and millers, Chrysotile	Decreased risk of non-malignant abnormalities with improvements in workplace conditions.
Nayebzadeh <i>et al.</i> , 2006	Canadian miners and millers, Chrysotile, Tremolite, Amosite	Possible use of lung fiber concentration, especially short tremolite fibers, to predict fibrosis grade.
Sullivan, 2007	U.S. miners, millers, and processors, Tremolite	Increased mortality from asbestosis, cancer of the pleura, and lung cancer that were dose-related.

MSHA found that many of the observations presented in these mining studies (e.g., age of first exposure, latency, radiologic changes) are consistent with those from the studies OSHA relied on in its risk assessment, as well as studies of other asbestos-exposed factory and insulation workers.

MSHA concludes that exposure to asbestos, a known human carcinogen, results in similar disease endpoints regardless of the occupation that has been studied. Because there is evidence of asbestos-related disease among miners, MSHA is applying the OSHA risk assessment to the mining industry.

Some commentors stated that there is a differential health risk related to fiber type and that OSHA's risk assessment is not adequate or appropriate for the mining industry. The OSHA risk assessment addresses adverse health effects from exposure to six asbestos minerals. MSHA applies TEM analysis

to its PCM results to determine exposure to those same six asbestos minerals. Exposure of miners to these asbestos minerals, at the same concentrations and length of exposures as workers in other industries, can be expected to result in the same disease endpoints as quantified in OSHA's risk assessment. (See section II.C and II.D of this preamble and chapter III of the REA.)

Some commenters also expressed concern regarding the health risks of fibrous minerals that are not currently regulated under MSHA's existing standards and suggested that MSHA conduct a new risk assessment to include them. MSHA considered those comments and determined that a new risk assessment is not necessary for this

exposure levels currently existing in mines warrant regulatory action. The criteria for this evaluation are established by the Federal Mine Safety and Health Act of 1977 (Mine Act) and related court decisions.⁴⁵

Section 101(a) of the Mine Act requires MSHA " * * * to develop, promulgate, and revise * * * improved mandatory health or safety standards for the protection of life and prevention of injuries in coal or other mines." Further, section 101(a)(6)(A) provides that—

The Secretary, in promulgating mandatory standards dealing with toxic materials or harmful physical agents under this subsection, shall set standards which most adequately assure on the basis of the best available evidence that no miner will suffer material impairment of health or functional

hour TWA PEL to 0.1 f/cc, MSHA will reduce the risk of asbestos-related cancers from 6.4 percent to 0.34 percent and the risk of asbestosis from 5.0 percent to 0.25 percent. MSHA considers this reduction to be substantial.

V. Section-by-Section Analysis of Final Rule

The final rule is substantively the same as the proposed rule. To make the standard easier to read, however, MSHA has divided the requirements in the final standards into three paragraphs: *Definitions*, *Permissible Exposure Limits (PELs)*, and *Measurement of Airborne Fiber Concentration*. For §§ 56/57.5001(b), the metal and nonmetal

the term asbestos in MSHA's existing standards and this final rule is limited to the following six;⁴⁸

- Chrysotile (serpentine asbestos, white asbestos).

industry. MSHA's *Regulatory Economic Analysis* (REA) contains a more in-depth discussion of the Agency's methodology and conclusions. MSHA placed the REA in the rulemaking docket and posted it on the Asbestos Single Source Page at <http://www.msha.gov/asbestos/asbestos.htm>. MSHA also placed OSHA's risk assessment in its rulemaking docket.

C. Characterization of the Risk to Miners

After reviewing the evidence of adverse health effects associated with exposure to asbestos, MSHA evaluated that evidence to ascertain whether

(2) Will exposed miners at significant risk of incurring any of these material impairments? Based on OSHA's risk assessment, MSHA has determined that a significant health risk exists for miners exposed to asbestos at MSHA's existing 8-hour TWA PEL of 2 f/cc. Over a 45-year working life, exposure at this level can be expected to result in a 6.4 percent incidence of cancer (lung cancer, mesotheliomas, and gastrointestinal cancer) and a 5.0 percent incidence of asbestosis.

(3) Will this final rule substantially reduce such risks? By lowering the 8-

white asbestos).

- Cumingtonite-grunerite asbestos (amosite, brown asbestos).
- Crocidolite (riebeckite asbestos, blue asbestos).
- Anthophyllite asbestos (asbestiform anthophyllite).
- Tremolite asbestos (asbestiform tremolite).
- Actinolite asbestos (asbestiform actinolite).

Like the proposal, the final rule makes several clarifying changes to the existing regulatory language. They have no impact on the minerals that MSHA regulates as asbestos. This more precise

⁴³ Sullivan, 2007.

⁴⁴ NIOSH (HETA/MHETA), 1990; NIOSH (Technical Report), 1990.

⁴⁵ *Industrial Union Department, AFL-CIO v. American Petroleum Institute*, 448 U.S. 607, 100 S.Ct. 2844 (1980) ("Benzene case").

⁴⁶ American Thoracic Society, 2004; Delpierre et al., 2002.

⁴⁷ Leake et al., 1997; Meeker et al., 2003.

⁴⁸ ATSDR, p.136, 2001; NIOSH Pocket Guide, 2003.



back to SAFETY AND HEALTH TOPICS

During the removal of asbestos materials used for insulating ship hulls, asbestiform minerals are commonly released into the air during the manufacture of asbestos products (such as textiles, friction products, insulation, and other building materials) and during automotive brake and clutch repair work.

What are the hazards of asbestos?

Asbestos is well recognized as a health hazard and its use is now highly regulated by both OSHA and EPA. Asbestos fibers associated with these health risks are too small to be seen with the naked eye. Breathing asbestos fibers can cause a buildup of scar-like tissue in the lungs called asbestosis and result in loss of lung function that often progresses to disability and death. Asbestos also causes cancer of the lung and other diseases such as mesothelioma of the pleura which is a fatal malignant tumor of the membrane lining the cavity of the lung or stomach. Epidemiologic evidence has increasingly shown that all asbestos fiber types, including the most commonly used form of asbestos, chrysotile, causes mesothelioma in humans.²

What can be done to reduce the hazards of asbestos?

Page last reviewed: 04/20/2014

Highlights

- ☒ [Self-Inspection Checklist](#)
OSHA. Use this checklist to determine compliance to the asbestos standard.

Other Related Topics

- [Carcinogens](#)
- [Hazardous and Toxic Substances](#)
- [Hazardous Waste](#)

There is no “safe” level of asbestos exposure for any type of asbestos fiber. **Asbestos exposures as short in duration as a few days have caused mesothelioma in humans.** Every occupational exposure to asbestos can cause injury [or] disease; every occupational exposure to asbestos contributes to the risk of getting an asbestos related disease.

² Executive, Magbilen House, Stanley Princt, L20 300, Boise, UT, 2008.

² Hammar SP, Henderson DW, Klebe S, Dodson RF. "Chapter 43: Neoplasms of the pleura." In: Tarnashchik JF Jr., ed. Cell and Hammar's Pathology, 3rd Edition. New York: Springer, 2008.