29 CFR 1910.1001 (1987)

TABLE Z-3—MINERAL DUSTS

Substance	Mppcf[1]	Mg/M³
Silica:		
Crystalline:		
Quartz (respirable)	250 [2]	10mg/M³ [3]
	%SiO₂ + 5	%SiO₂ + 2
Quartz (total dust)		30mg/M³
		%SiO₂ + 2
Cristobalite: Use ½ the value calculated from the count or mass formulae for quartz		
Tridymite: Use ½ the value calculated from the formulae for quartz		
Amorphous, including natural diatomaceous earth	20	80mg/M³
		%SiO₂
Silicates (less than 1% crystalline silica):		
Mica	20	
Soapstone	20	
Talc (non-asbestos-form)	20[4]	
Talc (fibrous). Use asbestos limit		
Tremolite (see talc, fibrous)		
Portland cement	50	
Graphite (natural)	15	
Coal dust (respirable fraction less than 5% SiO_2)		2.4mg/M³ or 10mg/M³
For more than 5% SiO_2		%SiO₂ + 2
Inert or Nuisance Dust:		
Respirable fraction	15	5mg/M³
Total dust	50	15mg/M³

NOTE: Conversion factors—mppcf x 35.3 = million particles per cubic meter = particles per c.c.

[1] Millions of particles per cubic foot of air, based on impinger samples counted by light-field technics.

[2] The percentage of crystalline silica in the formula is the amount determined from air-borne samples, except in those instances in which other methods have been shown to be applicable.

[3] Both concentration and percent quartz for the application of this limit are to be determined from the fraction passing a size-selector with the following characteristics:

[4] Containing < 1% quartz; if 1% quartz, use quartz limit.

Aerodynamic diameter (unit density sphere)	Percent passing selector
2	90
2.5	75
3.5	50
5.0	25
10	0

The measurements under this note refer to the use of an AEC instrument. The respirable fraction of coal dust is determined with a MRE; the figure corresponding to that of 2.4 Mg/M³ in the table for coal dust is 4.5 Mg/M³.

[39 FR 23502, June 27, 1974. Redesignated and amended at 40 FR 23072, May 28, 1975; 42 FR 22525, May 3, 1977; 43 FR 2600, Jan. 17, 1978; 43 FR 5963, Feb. 10, 1978; 43 FR 13563, Mar. 31, 1978; 43 FR 19624, May 5, 1978; 43 FR 27394, June 23, 1978; 43 FR 45809, Oct. 3, 1978; 43 FR 53007, Nov. 14, 1978; 43 FR 57602, Dec. 8, 1978; 46 FR 32022, June 19, 1981; 49 FR 25796, June 22, 1984; 50 FR 51173, Dec. 13, 1985; 51 FR 41477, Nov. 17, 1986]

§ 1910.1001 Asbestos, tremolite, anthophyllite, and actinolite.

(a) *Scope and application.* (1) This section applies to all occupational exposures to asbestos, tremolite, anthophyllite, and actinolite, in all industries covered by the Occupational Safety and Health Act, except as provided in paragraph (a)(2) of this section.

(2) This section does not apply to construction work as defined in 29 CFR 1910.12(b). [Exposure to asbestos, tremolite, anthophyllite, and actinolite in construction work is covered by 29 CFR 1926.58.]

(b) *Definitions.* "Action level" means an airborne concentration of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals, of 0.1 fiber per cubic centimeter (f/cc) of air calculated as an eight (8)—hour time-weighted average.

"Asbestos" includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated and/or altered.

"Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

"Authorized person" means any person authorized by the employer and required by work duties to be present in regulated areas.

"Director" means the Director of the National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, or designee.

"Employee exposure" means that exposure to airborne asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals that would occur if the employee were not using respiratory protective equipment.

"Fiber" means a particulate form of asbestos, tremolite, anthophyllite, or actinolite, 5 micrometers or longer, with a length-to-diameter rati least 3 to 1.

"High-efficiency particula (HEPA) filter" means a filter of trapping and retaining at lea percent of 0.3 micrometer d mono-disperse particles.

"Regulated area" means an tablished by the employer to cate areas where airborne co tions of asbestos, tremolite, phyllite, actinolite, or a comi of these minerals exceed, or sonably be expected to exce permissible exposure limit.

"Tremolite, anthophyllite, o lite" means the non-asbestos these minerals, and any of th erals that have been chemical ed and/or altered.

(c) *Permissible exposure limi* The employer shall ensure tha ployee is exposed to an airbo centration of asbestos, tremoli ophyllite, actinolite, or a com of these minerals in excess of per cubic centimeter of air as (8)-hour time-weighted averag as determined by the meth scribed in Appendix A of this or by an equivalent method.

(d) *Exposure monitoring.*— *eral.* (i) Determinations of e exposure shall be made from ing zone air samples that ar sentative of the 8-hour TWA employee.

(ii) Representative 8-hour T ployee exposures shall be det on the basis of one or more representing full-shift expos each shift for each employee job classification in each work

(2) *Initial monitoring.* (i) E ployer who has a workplace operation covered by this s except as provided for in pa (d)(2)(ii) and (d)(2)(iii) of this shall perform initial monitorir ployees who are, or may reaso expected to be exposed to concentrations at or above th level.

(ii) Where the employer h tored after December 20, 1985. monitoring satisfies all other ments of this section, the may rely on such earlier m

Asbestos, Tremolite, Anthophyllite, and Actinolite (29 CFR 1910.1001) (1987)
ACL Doc 21613 · Page 1 of 42
Published by AsbestosClaims.Law
asbestosclaims.law/library/21613/1



FR 27394, June 23, 1978; 43 FR
ct. 3, 1978; 43 FR 53007, Nov. 14,
FR 57602, Dec. 8, 1978; 46 FR
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FR 51173, Dec. 13, 1985; 51 FR
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01 Asbestos, tremolite, antho-
lite, and actinolite.

cope and application. (1) This
applies to all occupational ex-
to asbestos, tremolite, antho-
, and actinolite, in all indus-
overed by the Occupational
and Health Act, except as pro-
n paragraph (a)(2) of this sec-

This section does not apply to
uction work as defined in 29
1910.12(b). [Exposure to asbes-
emolite, anthophyllite, and ac-
e in construction work is covered
CFR 1926.58.]

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crocidolite, tremolite asbestos,
phyllite asbestos, actinolite as-
, and any of these minerals that
been chemically treated and/or
d.

sistant Secretary" means the As-
t Secretary of Labor for Occupa-
Safety and Health, U.S. Depart-
of Labor, or designee.

thorized person" means any
n authorized by the employer
required by work duties to be
nt in regulated areas.

rector" means the Director of
ational Institute for Occupation-
fety and Health, U.S. Depart-
of Health and Human Services,
signee.

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respiratory protective equip-

ber" means a particulate form of
stos, tremolite, anthophyllite, or
olite, 5 micrometers or longer,

with a length-to-diameter ratio of at least 3 to 1.

"High-efficiency particulate air (HEPA) filter" means a filter capable of trapping and retaining at least 99.97 percent of 0.3 micrometer diameter mono-disperse particles.

"Regulated area" means an area established by the employer to demarcate areas where airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals exceed, or can reasonably be expected to exceed, the permissible exposure limit.

"Tremolite, anthophyllite, or actinolite" means the non-asbestos form of these minerals, and any of these minerals that have been chemically treated and/or altered.

(c) *Permissible exposure limit (PEL).* The employer shall ensure that no employee is exposed to an airborne concentration of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals in excess of 0.2 fiber per cubic centimeter of air as an eight (8)-hour time-weighted average (TWA) as determined by the method prescribed in Appendix A of this section, or by an equivalent method.

(d) *Exposure monitoring.*—(1) *General.* (i) Determinations of employee exposure shall be made from breathing zone air samples that are representative of the 8-hour TWA of each employee.

(ii) Representative 8-hour TWA employee exposures shall be determined on the basis of one or more samples representing full-shift exposures for each shift for each employee in each job classification in each work area.

(2) *Initial monitoring.* (i) Each employer who has a workplace or work operation covered by this standard, except as provided for in paragraphs (d)(2)(ii) and (d)(2)(iii) of this section, shall perform initial monitoring of employees who are, or may reasonably be expected to be exposed to airborne concentrations at or above the action level.

(ii) Where the employer has monitored after December 20, 1985, and the monitoring satisfies all other requirements of this section, the employer may rely on such earlier monitoring results to satisfy the requirements of paragraph (d)(2)(i) of this section.

(iii) Where the employer has relied upon objective data that demonstrates that asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals is not capable of being released in airborne concentrations at or above the action level under the expected conditions of processing, use, or handling, then no initial monitoring is required.

(3) *Monitoring frequency (periodic monitoring) and patterns.* After the initial determinations required by paragraph (d)(2)(i) of this section, samples shall be of such frequency and pattern as to represent with reasonable accuracy the levels of exposure of the employees. In no case shall sampling be at intervals greater than six months for employees whose exposures may reasonably be foreseen to exceed the action level.

(4) *Changes in monitoring frequency.* If either the initial or the periodic monitoring required by paragraphs (d)(2) and (d)(3) of this section statistically indicates that employee exposures are below the action level, the employer may discontinue the monitoring for those employees whose exposures are represented by such monitoring.

(5) *Additional monitoring.* Notwithstanding the provisions of paragraphs (d)(2)(ii) and (d)(4) of this section, the employer shall institute the exposure monitoring required under paragraphs (d)(2)(i) and (d)(3) of this section whenever there has been a change in the production, process, control equipment, personnel or work practices that may result in new or additional exposures above the action level or when the employer has any reason to suspect that a change may result in new or additional exposures above the action level.

(6) *Method of monitoring.* (i) All samples taken to satisfy the monitoring requirements of paragraph (d) shall be personal samples collected following the procedures specified in Appendix A.

(ii) All samples taken to satisfy the monitoring requirements of paragraph (d) shall be evaluated using the OSHA Reference Method (ORM) specified in

Asbestos, Tremolite, Anthophyllite, and Actinolite (29 CFR 1910.1001) (1987)
ACL Doc 21613 · Page 2 of 42
Published by AsbestosClaims.Law
asbestosclaims.law/library/21613/2

Appendix A of this section, or an equivalent counting method.

(iii) If an equivalent method to the ORM is used, the employer shall ensure that the method meets the following criteria:

(A) Replicate exposure data used to establish equivalency are collected in side-by-side field and laboratory comparisons; and

(B) The comparison indicates that 90% of the samples collected in the range 0.5 to 2.0 times the permissible limit have an accuracy range of plus or minus 25 percent of the ORM results with a 95% confidence level as demonstrated by a statistically valid protocol; and

(C) The equivalent method is documented and the results of the comparison testing are maintained.

(iv) To satisfy the monitoring requirements of paragraph (d) of this section, employers must use the results of monitoring analysis performed by laboratories which have instituted quality assurance programs that include the elements as prescribed in Appendix A.

(7) *Employee notification of monitoring results.* (i) The employer shall, within 15 working days after the receipt of the results of any monitoring performed under the standard, notify the affected employees of these results in writing either either individually or by posting of results in an appropriate location that is accessible to affected employees.

(ii) The written notification required by paragraph (d)(7)(i) of this section shall contain the corrective action being taken by the employer to reduce employee exposure to or below the PEL, wherever monitoring results indicated that the PEL had been exceeded.

(e) *Regulated Areas.*—(1) *Establishment.* The employer shall establish regulated areas wherever airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals are in excess of the permissible exposure limit prescribed in paragraph (c) of this section.

(2) *Demarcation.* Regulated areas shall be demarcated from the rest of the workplace in any manner that minimizes the number of persons who will be exposed to asbestos, tremolite, anthophyllite, or actinolite.

(3) *Access.* Access to regulated areas shall be limited to authorized persons or to persons authorized by the Act or regulations issued pursuant thereto.

(4) *Provision of respirators.* Each person entering a regulated area shall be supplied with and required to use a respirator, selected in accordance with paragraph (g)(2) of this section.

(5) *Prohibited activities.* The employer shall ensure that employees do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in the regulated areas.

(f) *Methods of compliance.*—(1) *Engineering controls and work practices.* (i) The employer shall institute engineering controls and work practices to reduce and maintain employee exposure to or below the exposure limit prescribed in paragraph (c) of this section, except to the extent that such controls are not feasible.

(ii) Wherever the feasible engineering controls and work practices that can be instituted are not sufficient to reduce employee exposure to or below the permissible exposure limit prescribed in paragraph (c) of this section, the employer shall use them to reduce employee exposure to the lowest levels achievable by these controls and shall supplement them by the use of respiratory protection that complies with the requirements of paragraph (g) of this section.

(iii) For the following operations, wherever feasible engineering controls and work practices that can be instituted are not sufficient to reduce the employee exposure to or below the permissible exposure limit prescribed in paragraph (c) of this section, the employer shall use them to reduce employee exposure to or below 0.5 fiber per cubic centimeter of air (as an eight-hour time-weighted average) and shall supplement them by the use of any combination of respiratory protection that complies with the requirements of paragraph (g) of this section. work practices and feasible engineering controls that will reduce employee exposure to or below the permissible exposure limit prescribed in paragraph (c) of this section: Coupling cutoff in primary asbestos cement pipe facturing; sanding in primary a ondary asbestos cement sheet facturing; grinding in primary a ondary friction product manu ing; carding and spinning in dry processes; and grinding and sanc primary plastics manufacturing.

(iv) Local exhaust ventilation. exhaust ventilation and dust coll systems shall be designed, constr installed, and maintained in a ance with good practices such as found in the American Na Standard Fundamentals Gov the Design and Operation of Loc haust Systems, ANSI Z9.2-1979.

(v) Particular tools. All hand-o ed and power-operated tools would produce or release fibers bestos, tremolite, anthophyllite, olite, or a combination of these r als so as to expose employees to in excess of the exposure limi scribed in paragraph (c) of thi tion, such as, but not limited to, scorers, abrasive wheels, and shall be provided with local ex ventilation systems which compl paragraph (f)(1)(iv) of this sectio

(vi) Wet methods. Insofar as p cable, asbestos, tremolite, anthc lite, or actinolite shall be ha mixed, applied, removed, cut, s or otherwise worked in a wet stat ficient to prevent the emission c borne fibers so as to expose empl to levels in excess of the exp limit prescribed in paragraph (this section, unless the usefulne the product would be dimin thereby.

(vii) Materials containing asb tremolite, anthophyllite, or acti shall not be applied by spray met

(viii) Particular products and ations. No asbestos cement, m coating, grout, plaster, or simila terial containing asbestos, trem anthophyllite, or actinolite shall moved from bags, cartons, or containers in which they are shi without being either wetted, o closed, or ventilated so as to pr effectively the release of air fibers of asbestos, tremolite, a phyllite, actinolite, or a combin of these minerals so as to expos ployees to levels in excess of the

Asbestos, Tremolite, Anthophyllite, and Actinolite (29 CFR 1910.1001) (1987)
ACL Doc 21613 · Page 3 of 42
Published by AsbestosClaims.Law
asbestosclaims.law/library/21613/3

imizes the number of persons who be exposed to asbestos, tremolite, hophyllite, or actinolite.

i) *Access.* Access to regulated areas ll be limited to authorized persons o persons authorized by the Act or ulations issued pursuant thereto.

:) *Provision of respirators.* Each son entering a regulated area shall supplied with and required to use a irator, selected in accordance with agraph (g)(2) of this section.

:) *Prohibited activities.* The em-:er shall ensure that employees do eat, drink, smoke, chew tobacco or , or apply cosmetics in the regulat-reas.

) *Methods of compliance.*—(1) *En-ering controls and work practices.* The employer shall institute engi-ring controls and work practices to uce and maintain employee expo-to or below the exposure limit scribed in paragraph (c) of this sec-, except to the extent that such trols are not feasible.

) Wherever the feasible engineer-co[illegible]'s and work practices that be[illegible]tuted are not sufficient to uce employee exposure to or below permissible exposure limit pre-ed in paragraph (c) of this sec-, the employer shall use them to uce employee exposure to the st levels achievable by these con-s and shall supplement them by use of respiratory protection that plies with the requirements of graph (g) of this section.

i) For the following operations, rever feasible engineering controls work practices that can be insti-d are not sufficient to reduce the loyee exposure to or below the nissible exposure limit prescribed aragraph (c) of this section, the loyer shall use them to reduce em-ee exposure to or below 0.5 fiber cubic centimeter of air (as an t-hour time-weighted average) and l supplement them by the use of combination of respiratory protec-that complies with the require-ts of paragraph (g) of this section. s practices and feasible engineer-controls that will reduce employee osure to or below the permissible osure limit prescribed in paragraph f this section: Coupling cutoff in primary asbestos cement pipe manufacturing; sanding in primary and secondary asbestos cement sheet manufacturing; grinding in primary and secondary friction product manufacturing; carding and spinning in dry textile processes; and grinding and sanding in primary plastics manufacturing.

(iv) Local exhaust ventilation. Local exhaust ventilation and dust collection systems shall be designed, constructed, installed, and maintained in accordance with good practices such as those found in the American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, ANSI Z9.2-1979.

(v) Particular tools. All hand-operated and power-operated tools which would produce or release fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals so as to expose employees to levels in excess of the exposure limit prescribed in paragraph (c) of this section, such as, but not limited to, saws, scorers, abrasive wheels, and drills, shall be provided with local exhaust ventilation systems which comply with paragraph (f)(1)(iv) of this section.

(vi) Wet methods. Insofar as practicable, asbestos, tremolite, anthophyllite, or actinolite shall be handled, mixed, applied, removed, cut, scored, or otherwise worked in a wet state sufficient to prevent the emission of airborne fibers so as to expose employees to levels in excess of the exposure limit prescribed in paragraph (c) of this section, unless the usefulness of the product would be diminished thereby.

(vii) Materials containing asbestos, tremolite, anthophyllite, or actinolite shall not be applied by spray methods.

(viii) Particular products and operations. No asbestos cement, mortar, coating, grout, plaster, or similar material containing asbestos, tremolite, anthophyllite, or actinolite shall be removed from bags, cartons, or other containers in which they are shipped, without being either wetted, or enclosed, or ventilated so as to prevent effectively the release of airborne fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals so as to expose employees to levels in excess of the limit prescribed in paragraph (c) of this section.

(ix) Compressed air. Compressed air shall not be used to remove asbestos, tremolite, anthophyllite, or actinolite or materials containing asbestos, tremolite, anthophyllite, or actinolite, unless the compressed air is used in conjunction with a ventilation system designed to capture the dust cloud created by the compressed air.

(2) *Compliance program.* (i) Where the PEL is exceeded, the employer shall establish and implement a written program to reduce employee exposure to or below the limit by means of engineering and work practice controls as required by paragraph (f)(1) of this section, and by the use of respiratory protection where required or permitted under this section.

(ii) Such programs shall be reviewed and updated as necessary to reflect significant changes in the status of the employer's compliance program.

(iii) Written programs shall be submitted upon request for examination and copying to the Assistant Secretary, the Director, affected employees and designated employee representatives.

(iv) The employer shall not use employee rotation as a means of compliance with the PEL.

(g) *Respiratory protection*—(1) *General.* The employer shall provide respirators, and ensure that they are used, where required by this section. Respirators shall be used in the following circumstances:

(i) During the interval necessary to install or implement feasible engineering and work practice controls;

(ii) In work operations, such as maintenance and repair activities, or other activities for which engineering and work practice controls are not feasible;

(iii) In work situations where feasible engineering and work practice controls are not yet sufficient to reduce exposure to or below the exposure limit; and

(iv) In emergencies.

(2) *Respirator selection.* (i) Where respirators are required under this section, the employer shall select and provide, at no cost to the employee, the appropriate respirator as specified

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in Table 1. The employer shall select respirators from among those jointly approved as being acceptable for protection by the Mine Safety and Health Administration (MSHA) and by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 30 CFR Part 11.

(ii) The employer shall provide a powered, air-purifying respirator in lieu of any negative pressure respirator specified in Table 1 whenever:

(A) An employee chooses to use this type of respirator; and

(B) This respirator will provide adequate protection to the employee.

TABLE 1—RESPIRATORY PROTECTION FOR ASBESTOS, TREMOLITE, ANTHOPHYLLITE, AND ACTINOLITE FIBERS

Airborne concentration of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals	Required respirator
Not in excess of 2 f/cc (10 X PEL).	1. Half-mask air-purifying respirator, other than a disposable respirator, equipped with high-efficiency filters.
Not in excess of 10 f/cc (50 X PEL).	1. Full facepiece air-purifying respirator equipped with high-efficiency filters.
Not in excess of 20 f/cc (100 X PEL).	1. Any powered air-purifying respirator equipped with high-efficiency filters. 2. Any supplied-air respirator operated in continuous flow mode.
Not in excess of 200 f/cc (1000 X PEL).	1. Full facepiece supplied-air respirator operated in pressure demand mode.
Greater than 200 f/cc (> 1,000 X PEL) or unknown concentration.	1. Full facepiece supplied air respirator operated in pressure demand mode equipped with an auxiliary positive pressure self-contained breathing apparatus.

NOTE: a. Respirators assigned for higher environmental concentrations may be used at lower concentrations.
b. A high-efficiency filter means a filter that is at least 99.97 percent efficient against mono-dispersed particles of 0.3 micrometers or larger.

(3) *Respirator program.* (i) Where respiratory protection is required, the employer shall institute a respirator program in accordance with 29 CFR 1910.134(b), (d), (e), and (f).

(ii) The employer shall permit each employee who uses a filter respirator to change the filter elements whenever an increase in breathing resistance is detected and shall maintain an adequate supply of filter elements for this purpose.

(iii) Employees who wear respirators shall be permitted to leave the regulated area to wash their faces and respirator facepieces whenever necessary to prevent skin irritation associated with respirator use.

(iv) No employee shall be assigned to tasks requiring the use of respirators if, based upon his or her most recent examination, an examining physician determines that the employee will be unable to function normally wearing a respirator, or that the safety or health of the employee or other employees will be impaired by the use of a respirator. Such employee shall be assigned to another job or given the opportunity to transfer to a different position whose duties he or she is able to perform with the same employer, in the same geographical area and with the same seniority, status, and rate of pay the employee had just prior to such transfer, if such a different position is available.

(4) *Respirator fit testing.* (i) The employer shall ensure that the respirator issued to the employee exhibits the least possible facepiece leakage and that the respirator is fitted properly.

(ii) For each employee wearing negative pressure respirators, employers shall perform either quantitative or qualitative face fit tests at the time of initial fitting and at least every six months thereafter. The qualitative fit tests may be used only for testing the fit of half-mask respirators where they are permitted to be worn, and shall be conducted in accordance with Appendix C. The tests shall be used to select facepieces that provide the required protection as prescribed in Table I.

(h) *Protective work clothing and equipment*—(1) *Provision and use.* If an employee is exposed to asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals above the PEL, or where the possibility of eye irritation exists, the employer shall provide at no cost to the employee and ensure that the employee uses appropriate protective work clothing and equipment such as, but not limited to:

(i) Coveralls or similar full-body work clothing;

(ii) Gloves, head coverings, coverings; and

(iii) Face shields, vented go other appropriate protectiv ment which complies with § of this Part.

(2) *Removal and storage.* (i) ployer shall ensure that e remove work clothing cont with asbestos, tremolite, an lite, or actinolite only in chan provided in accordance wit graph (i)(1) of this section.

(ii) The employer shall ens no employee takes contamina clothing out of the chang except those employees auth do so for the purpose of lau maintenance, or disposal.

(iii) Contaminated work shall be placed and stored i containers which prevent disp the asbestos, tremolite, antho and actinolite outside the cont

(iv) Containers of contamin tective devices or work clothir are to be taken out of change the workplace for cleaning, nance or disposal, shall bear accordance with paragraph this section.

(3) *Cleaning and replacem* The employer shall clean, repair, or replace protective and equipment required by th graph to maintain their effec The employer shall provide cl tective clothing and equipr least weekly to each affected ee.

(ii) The employer shall prot removal of asbestos, tremolite phyllite, and actinolite from pr clothing and equipment by bl shaking.

(iii) Laundering of conta clothing shall be done so as to the release of airborne fibers tos, tremolite, anthophyllite, lite, or a combination of thes als in excess of the permissib sure limit prescribed in parag of this section.

(iv) Any employer who gi taminated clothing to anothe for laundering shall inform person of the requirement graph (h)(3)(iii) of this sectio fectively prevent the release

·quate supply of filter elements for s purpose.

iii) Employees who wear respirators all, be permitted to leave the regued area to wash their faces and res·ator facepieces whenever necessary prevent skin irritation associated th respirator use.

iv) No employee shall be assigned to sks requiring the use of respirators based upon his or her most recent :amination, an examining physician :termines that the employee will be nable to function normally wearing a ·spirator, or that the safety or health f the employee or other employees ill be impaired by the use of a respiator. Such employee shall be assigned o another job or given the opportuniy to transfer to a different position :hose duties he or she is able to perorm with the same employer, in the ame geographical area and with the ame seniority, status, and rate of pay he employee had just prior to such :ransfer, if such a different position is ava(e.

(4(;pirator fit testing. (i) The employer shall ensure that the respirator issued to the employee exhibits the least possible facepiece leakage and that the respirator is fitted properly.

(ii) For each employee wearing negative pressure respirators, employers shall perform either quantitative or qualitative face fit tests at the time of initial fitting and at least every six months thereafter. The qualitative fit tests may be used only for testing the fit of half-mask respirators where they are permitted to be worn, and shall be conducted in accordance with Appendix C. The tests shall be used to select facepieces that provide the required protection as prescribed in Table I.

(h) *Protective work clothing and equipment*—(1) *Provision and use.* If an employee is exposed to asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals above the PEL, or where the possibility of eye irritation exists, the employer shall provide at no cost to the employee and ensure that the employee uses appropriate protective work clothing and equipment such as, but not limited to:

(i) Coveralls or similar full-body work clothing;

(ii) Gloves, head coverings, and foot coverings; and

(iii) Face shields, vented goggles, or other appropriate protective equipment which complies with § 1910.133 of this Part.

(2) *Removal and storage.* (i) The employer shall ensure that employees remove work clothing contaminated with asbestos, tremolite, anthophyllite, or actinolite only in change rooms provided in accordance with paragraph (i)(1) of this section.

(ii) The employer shall ensure that no employee takes contaminated work clothing out of the change room, except those employees authorized to do so for the purpose of laundering, maintenance, or disposal.

(iii) Contaminated work clothing shall be placed and stored in closed containers which prevent dispersion of the asbestos, tremolite, anthophyllite, and actinolite outside the container.

(iv) Containers of contaminated protective devices or work clothing which are to be taken out of change rooms or the workplace for cleaning, maintenance or disposal, shall bear labels in accordance with paragraph (j)(2) of this section.

(3) *Cleaning and replacement.* (i) The employer shall clean, launder, repair, or replace protective clothing and equipment required by this paragraph to maintain their effectiveness. The employer shall provide clean protective clothing and equipment at least weekly to each affected employee.

(ii) The employer shall prohibit the removal of asbestos, tremolite, anthophyllite, and actinolite from protective clothing and equipment by blowing or shaking.

(iii) Laundering of contaminated clothing shall be done so as to prevent the release of airborne fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals in excess of the permissible exposure limit prescribed in paragraph (c) of this section.

(iv) Any employer who gives contaminated clothing to another person for laundering shall inform such person of the requirement in paragraph (h)(3)(iii) of this section to effectively prevent the release of airborne fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals in excess of the permissible exposure limit.

(v) The employer shall inform any person who launders or cleans protective clothing or equipment contaminated with asbestos, tremolite, anthophyllite, or actinolite, of the potentially harmful effects of exposure to asbestos, tremolite, anthophyllite, or actinolite.

(vi) Contaminated clothing shall be transported in sealed impermeable bags, or other closed, impermeable containers, and labeled in accordance with paragraph (j) of this seciton.

(i) *Hygiene facilities and practices*—(1) *Change rooms.* (i) The employer shall provide clean change rooms for employees who work in areas where their airborne exposure to asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals is above the permissible exposure limit.

(ii) The employer shall ensure that change rooms are in accordance with § 1910.141(e) of this part, and are equipped with two separate lockers or storage facilities, so separated as to prevent contamination of the employee's street clothes from his protective work clothing and equipment.

(2) *Showers.* (i) The employer shall ensure that employees who work in areas where their airborne exposure is above the permissible exposure limit shower at the end of the work shift.

(ii) The employer shall provide shower facilities which comply with § 1910.141(d)(3) of this part.

(iii) The employer shall ensure that employees who are required to shower pursuant to paragraph (i)(2)(i) of this section do not leave the workplace wearing any clothing or equipment worn during the work shift.

(3) *Lunchrooms.* (i) The employer shall provide lunchroom facilities for employees who work in areas where their airborne exposure is above the permissible exposure limit.

(ii) The employer shall ensure that lunchroom facilities have a positive pressure, filtered air supply, and are readily accessible to employees.

(iii) The employer shall ensure that employees who work in areas where their airborne exposure is above the

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permissible exposure limit wash their hands and faces prior to eating, drinking or smoking.

(iv) The employer shall ensure that employees do not enter lunchroom facilities with protective work clothing or equipment unless surface asbestos, tremolite, anthophyllite, and actinolite fibers have been removed from the clothing or equipment by vacuuming or other method that removes dust without causing the asbestos, tremolite, anthophyllite, or actinolite to become airborne.

(j) *Communication of hazards to employees*—(1) *Warning signs.* (i) Posting. Warning signs shall be provided and displayed at each regulated area. In addition, warning signs shall be posted at all approaches to regulated areas so that an employee may read the signs and take necessary protective steps before entering the area.

(ii) Sign specifications. The warning signs required by paragraph (j)(1)(i) of this section shall bear the following information:

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING
ARE REQUIRED IN THIS AREA

(iii) Where minerals in the regulated area are only tremolite, anthophyllite or actinolite, the employer may replace the term "asbestos" with the appropriate mineral name.

(2) *Warning labels.* (i) Labeling. Warning labels shall be affixed to all raw materials, mixtures, scrap, waste, debris, and other products containing asbestos, tremolite, anthophyllite, or actinolite fibers, or to their containers.

(ii) Label specifications. The labels shall comply with the requirements of 29 CFR 1910.1200(f) of OSHA's Hazard Communication standard, and shall include the following information:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

(iii) Where minerals to be labeled are only tremolite, anthophyllite, or actinolite, the employer may replace the term "asbestos" with the appropriate mineral name.

(3) *Material safety data sheets.* Employers who are manufacturers or importers of asbestos, tremolite, anthophyllite, or actinolite or asbestos, tremolite, anthophyllite, or actinolite products shall comply with the requirements regarding development of material safety data sheets as specified in 29 CFR 1910.1200(g) of OSHA's Hazard Communication standard, except as provided by paragraph (j)(4) of this section.

(4) The provisions for labels required by paragraph (j)(2) or for material safety data sheets required by paragraph (j)(3) do not apply where:

(i) Asbestos, tremolite, anthophyllite, or actinolite fibers have been modified by a bonding agent, coating, binder, or other material provided that the manufacturer can demonstrate that during any reasonably foreseeable use, handling, storage, disposal, processing, or transportation, no airborne concentrations of fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals in excess of the action level will be released or

(ii) Asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals is present in a product in concentrations less than 0.1%.

(5) *Employee information and training.* (i) The employer shall institute a training program for all employees who are exposed to airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals at or above the action level and ensure their participation in the program.

(ii) Training shall be provided prior to or at the time of initial assignment and at least annually thereafter.

(iii) The training program shall be conducted in a manner which the employee is able to understand. The employer shall ensure that each employee is informed of the following:

(A) The health effects associated with asbestos, tremolite, anthophyllite, or actinolite exposure;

(B) The relationship betwee ing and exposure to asbestos, lite, anthophyllite, and actin producing lung cancer;

(C) The quantity, location, of use, release, and storage of a tremolite, anthophyllite, or ac and the specfic nature of op which could result in exposur bestos, tremolite, anthophyllit tinolite;

(D) The engineering contr work practices associated with ployee's job assignment;

(E) The specific procedures mented to protect employees f posure to asbestos, tremolite, phyllite, or actinolite, such as priate work practices, emerge clean-up procedures, and perso tective equipment to be used;

(F) The purpose, proper u limitations of respirators and tive clothing;

(G) The purpose and a descri the medical surveillance prog quired by paragraph (l) of this

(H) The content of this stanc cluding appendices.

(iv) Access to information an ing materials.

(A) The employer shall mak of this standard and its ap readily available without cost t fected employees.

(B) The employer shall upon request, all materials rel the employee information an ing program to the Assistant S and the training program to sistant Secretary and the Direc

(k) *Housekeeping.* (1) All shall be maintained as free as p ble of accumulations of du waste containing asbestos, tr anthophyllite, or actinolite.

(2) All spills and sudden rel material containing asbestos, lite, anthophyllite, or actinoli be cleaned up as soon as possib

(3) Surfaces contaminated bestos, tremolite, anthophyllit tinolite may not be cleaned by of compressed air.

(4) Vacuuming. HEPA-filte cuuming equipment shall be vacuuming. The equipment used and emptied in a manne minimizes the reentry of asbes

(iii) Where minerals to be labeled re only tremolite, anthophyllite, or ctinolite, the employer may replace he term "asbestos" with the appropri-te mineral name.

(3) *Material safety data sheets.* Em-)loyers who are manufacturers or im-)orters of asbestos, tremolite, antho-)hyllite, or actinolite or asbestos, tre-nolite, anthophyllite, or actinolite)roducts shall comply with the re-)uirements regarding development of naterial safety data sheets as speci-ied in 29 CFR 1910.1200(g) of OSHA's Hazard Communication standard,)xcept as provided by paragraph (j)(4))f this section.

(4) The provisions for labels required by paragraph (j)(2) or for material safety data sheets required by para-graph (j)(3) do not apply where:

(i) Asbestos, tremolite, anthophyl-lite, or actinolite fibers have been modified by a bonding agent, coating, binder, or other material provided that the manufacturer can demon-str[illegible] that during any reasonably for[illegible]ble use, handling, storage, dispos[illegible]rocessing, or transportation, no airborne concentrations of fibers of as-bestos, tremolite, anthophyllite, actin-olite, or a combination of these miner-als in excess of the action level will be released or

(ii) Asbestos, tremolite, anthophyl-lite, actinolite, or a combination of these minerals is present in a product in concentrations less than 0.1%.

(5) *Employee information and train-ing.* (i) The employer shall institute a training program for all employees who are exposed to airborne concen-trations of asbestos, tremolite, antho-phyllite, actinolite, or a combination of these minerals at or above the action level and ensure their participa-tion in the program.

(ii) Training shall be provided prior to or at the time of initial assignment and at least annually thereafter.

(iii) The training program shall be conducted in a manner which the em-ployee is able to understand. The em-ployer shall ensure that each employ-ee is informed of the following:

(A) The health effects associated with asbestos, tremolite, anthophyl-lite, or actinolite exposure;

(B) The relationship between smok-ing and exposure to asbestos, tremo-lite, anthophyllite, and actinolite in producing lung cancer;

(C) The quantity, location, manner of use, release, and storage of asbestos, tremolite, anthophyllite, or actinolite, and the specfic nature of operations which could result in exposure to as-bestos, tremolite, anthophyllite,or ac-tinolite;

(D) The engineering controls and work practices associated with the em-ployee's job assignment;

(E) The specific procedures imple-mented to protect employees from ex-posure to asbestos, tremolite, antho-phyllite, or actinolite, such as appro-priate work practices, emergency and clean-up procedures, and personal pro-tective equipment to be used;

(F) The purpose, proper use, and limitations of respirators and protec-tive clothing;

(G) The purpose and a description of the medical surveillance program re-quired by paragraph (l) of this section;

(H) The content of this standard, in-cluding appendices.

(iv) Access to information and train-ing materials.

(A) The employer shall make a copy of this standard and its appendices readily available without cost to all af-fected employees.

(B) The employer shall provide, upon request, all materials relating to the employee information and train-ing program to the Assistant Secretary and the training program to the As-sistant Secretary and the Director.

(k) *Housekeeping.* (1) All surfaces shall be maintained as free as practica-ble of accumulations of dusts and waste containing asbestos, tremolite, anthophyllite, or actinolite.

(2) All spills and sudden releases of material containing asbestos, tremo-lite, anthophyllite, or actinolite shall be cleaned up as soon as possible.

(3) Surfaces contaminated with as-bestos, tremolite, anthophyllite, or ac-tinolite may not be cleaned by the use of compressed air.

(4) Vacuuming. HEPA-filtered va-cuuming equipment shall be used for vacuuming. The equipment shall be used and emptied in a manner which minimizes the reentry of asbestos, tre-molite, anthophyllite, or actinolite into the workplace.

(5) Shoveling, dry sweeping and dry clean-up of asbestos, tremolite, antho-phyllite, or actinolite may be used only where vacuuming and/or wet cleaning are not feasible.

(6) Waste disposal. Waste, scrap, debris, bags, containers, equipment, and clothing contaminated with asbes-tos, tremolite, anthophyllite, or actin-olite consigned for disposal, shall be collected and disposed of in sealed im-permeable bags, or other closed, im-permeable containers.

(l) *Medical surveillance*—(1) *Gener-al*—(i) *Employees covered.* The em-ployer shall institute a medical surveil-lance program for all employees who are or will be exposed to airborne con-centrations of fibers of asbestos, tre-molite, anthophyllite, actinolite, or a combination of these minerals at or above the action level.

(ii) *Examination by a physician.* (A) The employer shall ensure that all medical examinations and procedures are performed by or under the super-vision of a licensed physician, and shall be provided without cost to the employee and at a reasonable time and place.

(B) Persons other than licensed phy-sicians, who administer the pulmonary function testing required by this sec-tion, shall complete a training course in spirometry sponsored by an appro-priate academic or professional insti-tution.

(2) *Preplacement examinations.* (i) Before an employee is assigned to an occupation exposed to airborne con-centrations of asbestos, tremolite, anthophyllite, or actinolite fibers, a preplacement medical examination shall be provided or made available by the employer.

(ii) Such examination shall include, as a minimum, a medical and work his-tory; a complete physical examination of all systems with emphasis on the respiratory system, the cardiovascular system and digestive tract; completion of the respiratory disease standardized questionnaire in Appendix D, Part 1; a chest roentgenogram (posterior-anteri-or 14x17 inches); pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume

Asbestos, Tremolite, Anthophyllite, and Actinolite (29 CFR 1910.1001) (1987)
ACL Doc 21613 · Page 8 of 42
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asbestosclaims.law/library/21613/8

at 1 second ($FEV_{1.0}$); and any additional tests deemed appropriate by the examining physician. Interpretation and classification of chest roentgenograms shall be conducted in accordance with Appendix E.

(3) *Periodic examinations.* (i) Periodic medical examinations shall be made available annually.

(ii) The scope of the medical examination shall be in conformance with the protocol established in paragraph (l)(2)(ii) of this section, except that the frequency of chest roentgenograms shall be conducted in accordance with Table 2, and the abbreviated standardized questionnaire contained in Appendix D, Part 2, shall be administered to the employee.

TABLE 2—FREQUENCY OF CHEST ROENTGENOGRAMS

Years since first exposure	Age of employee		
	15 to 35	35 + to 45	45 +
0 to 10	Every 5 years	Every 5 years	Every 5 years.
10 +	Every 5 years	Every 2 years	Every 1 year.

(4) *Termination of employment examinations.* (i) The employer shall provide, or make available, a termination of employment medical examination for any employee who has been exposed to airborne concentrations of fibers of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals at or above the action level.

(ii) The medical examination shall be in accordance with the requirements of the periodic examinations stipulated in paragraph (l)(3) of this section, and shall be given within 30 calendar days before or after the date of termination of employment.

(5) *Recent examinations.* No medical examination is required of any employee, if adequate records show that the employee has been examined in accordance with any of the preceding paragraphs [(l)(2)-(l)(4)] within the past 1 year period.

(6) *Information provided to the physician.* The employer shall provide the following information to the examining physician:

(i) A copy of this standard and Appendices D and E.

(ii) A description of the affected employee's duties as they relate to the employee's exposure.

(iii) The employee's representative exposure level or anticipated exposure level.

(iv) A description of any personal protective and respiratory equipment used or to be used.

(v) Information from previous medical examinations of the affected employee that is not otherwise available to the examining physician.

(7) *Physician's written opinion.* (i) The employer shall obtain a written signed opinion from the examining physician. This written opinion shall contain the results of the medical examination and shall include:

(A) The physician's opinion as to whether the employee has any detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos, tremolite, anthophyllite, or actinolite;

(B) Any recommended limitations on the employee or upon the use of personal protective equipment such as clothing or respirators; and

(C) A statement that the employee has been informed by the physician of the results of the medical examination and of any medical conditions resulting from asbestos, tremolite, anthophyllite, or actinolite exposure that require further explanation or treatment.

(ii) The employer shall instruct the physician not to reveal in the written opinion given to the employer specific findings or diagnoses unrelated to occupational exposure to asbestos, tremolite, anthophyllite, or actinolite.

(iii) The employer shall provide copy of the physician's written op ion to the affected employee within days from its receipt.

(m) *Recordkeeping.*—(1) *Expos measurements.* (i) The employer sh keep an accurate record of all me urements taken to monitor emplo exposure to asbestos, tremolite, anth phyllite, or actinolite as prescribed paragraph (d) of this section.

(ii) This record shall include at le the following information:

(A) The date of measurement;

(B) The operation involving ex sure to asbestos, tremolite, anthoph lite, or actinolite which is being mo tored;

(C) Sampling and analytical me ods used and evidence of their accu cy;

(D) Number, duration, and results samples taken;

(E) Type of respiratory protect devices worn, if any; and

(F) Name, social security num and exposure of the employees wh exposure are represented.

(iii) The employer shall maint this record for at least thirty years, in accordance with 29 C 1910.20.

(2) *Objective data for exempted o ations.* (i) Where the processing, or handling of products made from containing asbestos, tremolite, ant phyllite, or actinolite is exemp from other requirements of this tion under paragraph (d)(2)(iii) of section, the employer shall estab and maintain an accurate record of jective data reasonably relied upo support of the exemption.

(ii) The record shall include at l the following:

(A) The product qualifying for emption;

(B) The source of the objective d

(C) The testing protocol, result testing, and/or analysis of the ma al for the release of asbestos, tre lite, anthophyllite, or actinolite;

(D) A description of the opera exempted and how the data sup the exemption; and

(E) Other data relevant to the o ations, materials, processing, or ployee exposures covered by the emption.

protocol established in paragraph 2)(ii) of this section, except that frequency of chest roentgenoms shall be conducted in accordce with Table 2, and the abbreviated ndardized questionnaire contained Appendix D, Part 2, shall be adminred to the employee.

T ROENTGENOGRAMS

Age of employee		
15 to 35	35+ to 45	45+
ery 5 years	Every 5 years	Every 5 years.
ery 5 years	Every 2 years	Every 1 year.

iv) A description of any personal otective and respiratory equipment ed or to be used.

v) Information from previous medil examinations of the affected emoy (at is not otherwise available t. (amining physician.

7) *Physician's written opinion.* (i) ne employer shall obtain a written gned opinion from the examining ysician. This written opinion shall ntain the results of the medical exnination and shall include:

(A) The physician's opinion as to hether the employee has any detectl medical conditions that would place ie employee at an increased risk of aterial health impairment from exosure to asbestos, tremolite, anthohyllite, or actinolite;

(B) Any recommended limitations on ie employee or upon the use of peronal protective equipment such as othing or respirators; and

(C) A statement that the employee as been informed by the physician of ne results of the medical examination nd of any medical conditions resultng from asbestos, tremolite, anthohyllite, or actinolite exposure that equire further explanation or treatnent.

(ii) The employer shall instruct the hysician not to reveal in the written pinion given to the employer specific indings or diagnoses unrelated to occupational exposure to asbestos, trenolite, anthophyllite, or actinolite.

(iii) The employer shall provide a copy of the physician's written opinion to the affected employee within 30 days from its receipt.

(m) *Recordkeeping.*—(1) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to monitor employee exposure to asbestos, tremolite, anthophyllite, or actinolite as prescribed in paragraph (d) of this section.

(ii) This record shall include at least the following information:

(A) The date of measurement;

(B) The operation involving exposure to asbestos, tremolite, anthophyllite, or actinolite which is being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy;

(D) Number, duration, and results of samples taken;

(E) Type of respiratory protective devices worn, if any; and

(F) Name, social security number and exposure of the employees whose exposure are represented.

(iii) The employer shall maintain this record for at least thirty (30) years, in accordance with 29 CFR 1910.20.

(2) *Objective data for exempted operations.* (i) Where the processing, use, or handling of products made from or containing asbestos, tremolite, anthophyllite, or actinolite is exempted from other requirements of this section under paragraph (d)(2)(iii) of this section, the employer shall establish and maintain an accurate record of objective data reasonably relied upon in support of the exemption.

(ii) The record shall include at least the following:

(A) The product qualifying for exemption;

(B) The source of the objective data;

(C) The testing protocol, results of testing, and/or analysis of the material for the release of asbestos, tremolite, anthophyllite, or actinolite;

(D) A description of the operation exempted and how the data support the exemption; and

(E) Other data relevant to the operations, materials, processing, or employee exposures covered by the exemption.

(iii) The employer shall maintain this record for the duration of the employer's reliance upon such objective data.

NOTE: The employer may utilize the services of competent organizations such as industry trade associations and employee associations to maintain the records required by this section.

(3) *Medical surveillance.* (i) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance by paragraph (l)(1)(i) of this section, in accordance with 29 CFR 1910.20.

(ii) The record shall include at least the following information:

(A) The name and social security number of the employee;

(B) Physician's written opinions;

(C) Any employee medical complaints related to exposure to asbestos, tremolite, anthophyllite, or actinolite; and

(D) A copy of the information provided to the physician as required by paragraph (l)(6) of this section.

(iii) The employer shall ensure that this record is maintained for the duration of employment plus thirty (30) years, in accordance with 29 CFR 1910.20.

(4) *Training.* The employer shall maintain all employee training records for one (1) year beyond the last date of employment of that employee.

(5) *Availability.* (i) The employer, upon written request, shall make all records required to be maintained by this section available to the Assistant Secretary and the Director for examination and copying.

(ii) The employer, upon request shall make any exposure records required by paragraph (m)(1) of this section available for examination and copying to affected employees, former employees, designated representatives and the Assistant Secretary, in accordance with 29 CFR 1910.20 (a)-(e) and (g)-(i).

(iii) The employer, upon request, shall make employee medical records required by paragraph (m)(2) of this section available for examination and copying to the subject employee, to anyone having the specific written consent of the subject employee, and

Asbestos, Tremolite, Anthophyllite, and Actinolite (29 CFR 1910.1001) (1987)
ACL Doc 21613 · Page 10 of 42
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the Assistant Secretary, in accordance with 29 CFR 1910.20.

(6) *Transfer of records.* (i) The employer shall comply with the requirements concerning transfer of records set forth in 29 CFR 1910.20(h).

(ii) Whenever the employer ceases to do business and there is no successor employer to receive and retain the records for the prescribed period, the employer shall notify the Director at least 90 days prior to disposal of records and, upon request, transmit them to the Director.

(n) *Observation of monitoring*—(1) *Employee observation.* The employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to asbestos, tremolite, anthophyllite, or actinolite conducted in accordance with paragraph (d) of this section.

(2) *Observation procedures.* When observation of the monitoring of employee exposure to asbestos, tremolite, anthophyllite, or actinolite requires entry into an area where the use of protective clothing or equipment is required, the observer shall be provided with and be required to use such clothing and equipment and shall comply with all other applicable safety and health procedures.

(o) *Dates*—(1) *Effective date.* This standard shall become effective July 21, 1986. The requirements of the asbestos standard issued in June 1972 (37 FR 11318), as amended, and published in 29 CFR 1910.1101 remain in effect until compliance is achieved with the parallel provisions of this standard.

(2) *Start-up dates.* All obligations of this standard commence on the effective date except as follows:

(i) *Exposure monitoring.* Initial monitoring required by paragraph (d)(2) of this section shall be completed as soon as possible but no later than October 20, 1986.

(ii) *Regulated areas.* Regulated areas required to be established by paragraph (e) of this section as a result of initial monitoring shall be set up as soon as possible after the results of that monitoring are known and not later than November 17, 1986.

(iii) *Respiratory protection.* Respiratory protection required by paragraph (g) of this section shall be provided as soon as possible but no later than the following schedule:

(A) Employees whose 8-hour TWA exposure exceeds 2 fibers/cc—July 21, 1986.

(B) Employees whose 8-hour TWA exposure exceeds the PEL but is less than 2 fibers/cc—November 17, 1986.

(C) Powered air-purifying respirators provided under paragraph (g)(2)(ii)—January 16, 1987.

(iv) *Hygiene and lunchroom facilities.* Construction plans for changerooms, showers, lavatories, and lunchroom facilities shall be completed no later than January 16, 1987; and these facilities shall be constructed and in use no later than July 20, 1987. However, if as part of the compliance plan it is predicted by an independent engineering firm that engineering controls and work practices will reduce exposures below the permissible exposure limit by July 20, 1988, for affected employees, then such facilities need not be completed until 1 year after the engineering controls are completed, if such controls have not in fact succeeded in reducing exposure to below the permissible exposure limit.

(v) *Employee information and training.* Employee information and training required by paragraph (j)(5) of this section shall be provided as soon as possible but no later than October 20, 1986.

(vi) *Medical surveillance.* Medical examinations required by paragraph (l) of this section shall be provided as soon as possible but no later than November 17, 1986.

(vii) *Compliance program.* Written compliance programs required by paragraph (f)(2) of this section as a result of initial monitoring shall be completed and available for inspection and copying as soon as possible but no later than July 20, 1987.

(viii) *Methods of compliance.* The engineering and work practice controls as required by paragraph (f)(1) shall be implemented as soon as possible but no later than July 20, 1988.

(p) *Appendices.* (1) Appendices A, C, D, and E to this section are incorporated as part of this section and the contents of these Appendices are tory.

(2) Appendices B, F, G and section are informational and intended to create any additic gations not otherwise impos detract from any existing obli

APPENDIX A TO §1910.1001—OSH ENCE METHOD—MANDATORY

This mandatory appendix spe procedure for analyzing air sampl bestos, tremolite, anthophyllite, a lite and specifies quality control p that must be implemented by la performing the analysis. The sam analytical methods described bel sent the elements of the available ing methods (such as the NIC method) which OSHA considers tc tial to achieve adequate employee monitoring while allowing employ methods that are already establish their organizations. All employer required to conduct air monitori paragraph (d) of the standard are to utilize analytical laboratories this procedure, or an equivalent m collecting and analyzing samples.

Sampling and Analytical Proc

1. The sampling medium for ai shall be mixed cellulose ester fil branes. These shall be designate manufacturer as suitable for asb molite, anthophyllite, and actinol ing. See below for rejection of blan

2. The preferred collection devic the 25-mm diameter cassette with faced 50-mm electrically conducti sion cowl. The 37-mm cassette ma if necessary but only if written ju for the need to use the 37-mm filte accompanies the sample results i ployee's exposure monitoring reco

3. An air flow rate between 0.5 and 2.5 liters/min shall be selecte 25-mm cassette. If the 37-mm c used, an air flow rate between 1 and 2.5 liters/min shall be selected

4. Where possible, a sufficient a for each air sample shall be co yield between 100 and 1,300 f square millimeter on the membr If a filter darkens in appearance dust is seen on the filter, a seco shall be started.

5. Ship the samples in a rigid with sufficient packing material t dislodging the collected fibers. Pa terial that has a high electrosta on its surface (e.g., expanded po cannot be used because such ma cause loss of fibers to the sides c sette.

(iii) *Respiratory protection.* Respiratory protection required by paragraph) of this section shall be provided as on as possible but no later than the llowing schedule:

(A) Employees whose 8-hour TWA posure exceeds 2 fibers/cc—July 21, 86.

(B) Employees whose 8-hour TWA posure exceeds the PEL but is less an 2 fibers/cc—November 17, 1986.

(C) Powered air-purifying respirars provided under paragraph)(2)(ii)—January 16, 1987.

(iv) *Hygiene and lunchroom facilies.* Construction plans for changerooms, showers, lavatories, and lunchoom facilities shall be completed no ter than January 16, 1987; and these cilities shall be constructed and in se no later than July 20, 1987. However, if as part of the compliance plan is predicted by an independent engieering firm that engineering controls nd work practices will reduce exposres below the permissible exposure mit by July 20, 1988, for affected emlo (then such facilities need not e eted until 1 year after the engineering controls are completed, if uch controls have not in fact succeeded in reducing exposure to below the ermissible exposure limit.

(v) *Employee information and training.* Employee information and training required by paragraph (j)(5) of his section shall be provided as soon s possible but no later than October 0, 1986.

(vi) *Medical surveillance.* Medical xaminations required by paragraph) of this section shall be provided as oon as possible but no later than November 17, 1986.

(vii) *Compliance program.* Written ompliance programs required by aragraph (f)(2) of this section as a esult of initial monitoring shall be ompleted and available for inspection nd copying as soon as possible but no ater than July 20, 1987.

(viii) *Methods of compliance.* The engineering and work practice controls s required by paragraph (f)(1) shall e implemented as soon as possible ut no later than July 20, 1988.

(p) *Appendices.* (1) Appendices A, C, D, and E to this section are incorporated as part of this section and the contents of these Appendices are mandatory.

(2) Appendices B, F, G and H to this section are informational and are not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

Appendix A to §1910.1001—OSHA Reference Method—Mandatory

This mandatory appendix specifies the procedure for analyzing air samples for asbestos, tremolite, anthophyllite, and actinolite and specifies quality control procedures that must be implemented by laboratories performing the analysis. The sampling and analytical methods described below represent the elements of the available monitoring methods (such as the NIOSH 7400 method) which OSHA considers to be essential to achieve adequate employee exposure monitoring while allowing employers to use methods that are already established within their organizations. All employers who are required to conduct air monitoring under paragraph (d) of the standard are required to utilize analytical laboratories that use this procedure, or an equivalent method, for collecting and analyzing samples.

Sampling and Analytical Procedure

1. The sampling medium for air samples shall be mixed cellulose ester filter membranes. These shall be designated by the manufacturer as suitable for asbestos, tremolite, anthophyllite, and actinolite counting. See below for rejection of blanks.

2. The preferred collection device shall be the 25-mm diameter cassette with an open-faced 50-mm electrically conductive extension cowl. The 37-mm cassette may be used if necessary but only if written justification for the need to use the 37-mm filter cassette accompanies the sample results in the employee's exposure monitoring record.

3. An air flow rate between 0.5 liter/min and 2.5 liters/min shall be selected for the 25-mm cassette. If the 37-mm cassette is used, an air flow rate between 1 liter/min and 2.5 liters/min shall be selected.

4. Where possible, a sufficient air volume for each air sample shall be collected to yield between 100 and 1,300 fibers per square millimeter on the membrane filter. If a filter darkens in appearance or if loose dust is seen on the filter, a second sample shall be started.

5. Ship the samples in a rigid container with sufficient packing material to prevent dislodging the collected fibers. Packing material that has a high electrostatic charge on its surface (e.g., expanded polystyrene) cannot be used because such material can cause loss of fibers to the sides of the cassette.

6. Calibrate each personal sampling pump before and after use with a representative filter cassette installed between the pump and the calibration devices.

7. Personal samples shall be taken in the "breathing zone" of the employee (i.e., attached to or near the collar or lapel near the worker's face).

8. Fiber counts shall be made by positive phase contrast using a microscope with an 8 to 10 X eyepiece and a 40 to 45 X objective for a total magnification of approximately 400 X and a numerical aperture of 0.65 to 0.75. The microscope shall also be fitted with a green or blue filter.

9. The microscope shall be fitted with a Walton-Beckett eyepiece graticule calibrated for a field diameter of 100 micrometers (+/−2 micrometers).

10. The phase-shift detection limit of the microscope shall be about 3 degrees measured using the HSE phase shift test slide as outlined below.

a. Place the test slide on the microscope stage and center it under the phase objective.

b. Bring the blocks of grooved lines into focus.

Note: The slide consists of seven sets of grooved lines (ca. 20 grooves to each block) in descending order of visibility from sets 1 to 7, seven being the least visible. The requirements for asbestos, tremolite, anthophyllite, and actinolite counting are that the microscope optics must resolve the grooved lines in set 3 completely, although they may appear somewhat faint, and that the grooved lines in sets 6 and 7 must be invisible. Sets 4 and 5 must be at least partially visible but may vary slightly in visibility between microscopes. A microscope that fails to meet these requirements has either too low or too high a resolution to be used for asbestos, tremolite, anthophyllite, and actinolite counting.

c. If the image deteriorates, clean and adjust the microscope optics. If the problem persists, consult the microscope manufacturer.

11. Each set of samples taken will include 10 percent blanks or a minimum of 2 blanks. The blank results shall be averaged and subtracted from the analytical results before reporting. Any samples represented by a blank having a fiber count in excess of 7 fibers/100 fields shall be rejected.

12. The samples shall be mounted by the acetone/triacetin method or a method with an equivalent index of refraction and similar clarity.

13. Observe the following counting rules.

a. Count only fibers equal to or longer than 5 micrometers. Measure the length of curved fibers along the curve.

b. In the absence of other information, count all particles as asbestos, tremolite,

Asbestos, Tremolite, Anthophyllite, and Actinolite (29 CFR 1910.1001) (1987)
ACL Doc 21613 · Page 12 of 42
Published by AsbestosClaims.Law
asbestosclaims.law/library/21613/12

anthophyllite, and actinolite that have a length-to-width ratio (aspect ratio) of 3:1 or greater.

c. Fibers lying entirely within the boundary of the Walton-Beckett graticule field shall receive a count of 1. Fibers crossing the boundary once, having one end within the circle, shall receive the count of one half (½). Do not count any fiber that crosses the graticule boundary more than once. Reject and do not count any other fibers even though they may be visible outside the graticule area.

d. Count bundles of fibers as one fiber unless individual fibers can be identified by observing both ends of an individual fiber.

e. Count enough graticule fields to yield 100 fibers. Count a minimum of 20 fields; stop counting at 100 fields regardless of fiber count.

14. Blind recounts shall be conducted at the rate of 10 percent.

Quality Control Procedures

1. Intralaboratory program. Each laboratory and/or each company with more than one microscopist counting slides shall establish a statistically designed quality assurance program involving blind recounts and comparisons between microscopists to monitor the variability of counting by each microscopist and between microscopists. In a company with more than one laboratory, the program shall include all laboratories and shall also evaluate the laboratory-to-laboratory variability.

2. Interlaboratory program. Each laboratory analyzing asbestos, tremolite, anthophyllite, and actinolite samples for compliance determination shall implement an interlaboratory quality assurance program that as a minimum includes participation of at least two other independent laboratories. Each laboratory shall participate in round robin testing at least once every 6 months with at least all the other laboratories in its interlaboratory quality assurance group. Each laboratory shall submit slides typical of its own work load for use in this program. The round robin shall be designed and results analyzed using appropriate statistical methodology.

3. All individuals performing asbestos, tremolite, anthophyllite, and actinolite analysis must have taken the NIOSH course for sampling and evaluating airborne asbestos, tremolite, anthophyllite, and actinolite dust or an equalivalent course.

4. When the use of different microscopes contributes to differences between counters and laboratories, the effect of the different microscope shall be evaluated and the microscope shall be replaced, as necessary.

5. Current results of these quality assurance programs shall be posted in each laboratory to keep the microscopists informed.

APPENDIX B TO § 1910.1001—DETAILED PROCEDURE FOR ASBESTOS TREMOLITE, ANTHOPHYLLITE, AND ACTINOLITE SAMPLING AND ANALYSIS—NON-MANDATORY

This appendix contains a detailed procedure for sampling and analysis and includes those critical elements specified in Appendix A. Employers are not required to use this procedure, but they are required to use Appendix A. The purpose of Appendix B is to provide a detailed step-by-step sampling and analysis procedure that conforms to the elements specified in Appendix A. Since this procedure may also standardize the analysis and reduce variability, OSHA encourages employers to use this appendix.

Asbestos, Tremolite, Anthophyllite, and Actinolite Sampling and Analysis Method

Technique: Microscopy, Phase Contrast
Analyte: Fibers (manual count)
Sample Preparation: Acetone/triacetin method
Calibration: Phase-shift detection limit about 3 degrees
Range: 100 to 1300 fibers/mm ^{2} filter area
Estimated limit of detection: 7 fibers/mm ^{2} filter area
Sampler: Filter (0.8–1.2 um mixed cellulose ester membrane, 25-mm diameter)
Flow rate: 0.5 L/min to 2.5 L/min (25-mm cassette) 1.0 L/min to 2.5 L/min (37-mm cassette)
Sample volume: Adjust to obtain 100 to 1300 fibers/mm ^{2}
Shipment: Routine
Sample stability: Indefinite
Blanks: 10% of samples (minimum 2)
Standard analytical error: 0.25.

Applicability: The working range is 0.02 f/cc (1920-L air sample) to 1.25 f/cc (400-L air sample). The method gives an index of airborne asbestos, tremolite, anthophyllite, and actinolite fibers but may be used for other materials such as fibrous glass by inserting suitable parameters into the counting rules. The method does not differentiate between asbestos, tremolite, anthophyllite, and actinolite and other fibers. Asbestos, tremolite, anthophyllite, and actinolite fibers less than ca. 0.25 um diameter will not be detected by this method.

Interferences: Any other airborne fiber may interfere since all particles meeting the counting criteria are counted. Chainlike particles may appear fibrous. High levels of nonfibrous dust particles may obscure fibers in the field of view and raise the detection limit.

Reagents: 1. Acetone. 2. Triacetin (g
ol triacetate), reagent grade.

Special precautions: Acetone is a
tremely flammable liquid and preca
must be taken not to ignite it. Heating
etone must be done in a ventilated lat
ry fume hood using a flameless, spar
heat source.

Equipment: 1. Collection device:
cassette with 50-mm electrically cond
extension cowl with cellulose ester fil
to 1.2 mm pore size and backup pad.

NOTE: Analyze representative filt
fiber background before use and disc
filter lot if more than 5 fibers/100 fie
found.

2. Personal sampling pump, greate
or equal to 0.5 L/min, with flexible c
ing tubing.

3. Microscope, phase contrast, wit
or blue filter, 8 to 10X eyepiece, an
45X phase objective (total magnifica
400X; numerical aperture = 0.65 to 0

4. Slides, glass, single-frosted, pre-
25 x 75 mm.

5. Cover slips, 25 x 25 mm, no. 1
otherwise specified by microscope m
turer.

6. Knife, No. 1 surgical steel, curve

7. Tweezers.

8. Flask, Guth-type, insulated nec
500 mL (with single-holed rubber
and elbow-jointed glass tubing, 16
long).

9. Hotplate, spark-free, stirring ty
ing mantle; or infrared lamp and
stirrer.

10. Syringe, hypodermic, with
needle.

11. Graticule, Walton-Beckett t
100 um diameter circular field at
men plane (area = 0.00785 mm ^{2}).
22).

NOTE: the graticule is custom-
each microscope.

12. HSE/NPL phase contrast
Mark II.

13. Telescope, ocular phase-ring

14. Stage micrometer (0.01 mm

Sampling

1. Calibrate each personal samp
with a representative sampler in li

2. Fasten the sampler to the
lapel as close as possible to th
mouth. Remove the top cover fro
of the cowl extension (open face)
face down. Wrap the joint betwe
tender and the monitor's body w
tape to prevent air leaks.

3. Submit at least two blanks
the total samples, whichever is
each set of samples. Remove the
the field blank cassettes and sto
and cassettes in a clean area (t
during the sampling period. B

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PENDIX B TO § 1910.1001—DETAILED PROCE-URE FOR ASBESTOS TREMOLITE, ANTHO-HYLLITE, AND ACTINOLITE SAMPLING AND NALYSIS—NON-MANDATORY

This appendix contains a detailed proce-re for sampling and analysis and includes ose critical elements specified in Appen-: A. Employers are not required to use is procedure, but they are required to use pendix A. The purpose of Appendix B is provide a detailed step-by-step sampling d analysis procedure that conforms to the ments specified in Appendix A. Since this ocedure may also standardize the analysis d reduce variability, OSHA encourages ployers to use this appendix.

Asbestos, Tremolite, Anthophyllite, and ctinolite Sampling and Analysis Method

echnique: Microscopy, Phase Contrast
nalyte: Fibers (manual count)
ample Preparation: Acetone/triacetin method
alibration: Phase-shift detection limit about 3 degrees
ange: 100 to 1300 fibers/mm ² filter area
s (d limit of detection: 7 fibers/mm² filter area
ampler: Filter (0.8–1.2 um mixed cellulose ester membrane, 25-mm diameter)
low rate: 0.5 L/min to 2.5 L/min (25-mm cassette) 1.0 L/min to 2.5 L/min (37-mm cassette)
ample volume: Adjust to obtain 100 to 1300 fibers/mm ²
hipment: Routine
ample stability: Indefinite
lanks: 10% of samples (minimum 2)
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Applicability: The working range is 0.02 f/ (1920-L air sample) to 1.25 f/cc (400-L air ample). The method gives an index of air-orne asbestos, tremolite, anthophyllite, nd actinolite fibers but may be used for ther materials such as fibrous glass by in-erting suitable parameters into the count-ng rules. The method does not differentiate etween asbestos, tremolite, anthophyllite, nd actinolite and other fibers. Asbestos, remolite, anthophyllite, and actinolite bers less than ca. 0.25 um diameter will ot be detected by this method.

Interferences: Any other airborne fiber ay interfere since all particles meeting the ounting criteria are counted. Chainlike articles may appear fibrous. High levels of onfibrous dust particles may obscure fibers n the field of view and raise the detection mit.

Reagents: 1. Acetone. 2. Triacetin (glycer-triacetate), reagent grade

Special precautions: Acetone is an ex-remely flammable liquid and precautions ust be taken not to ignite it. Heating of ac-tone must be done in a ventilated laborato-y fume hood using a flameless, spark-free at source.

Equipment: 1. Collection device: 25-mm sette with 50-mm electrically conductive xtension cowl with cellulose ester filter, 0.8 1.2 mm pore size and backup pad.

NOTE: Analyze representative filters for ber background before use and discard the ter lot if more than 5 fibers/100 fields are und.

2. Personal sampling pump, greater than or equal to 0.5 L/min, with flexible connecting tubing.

3. Microscope, phase contrast, with green or blue filter, 8 to 10X eyepiece, and 40 to 45X phase objective (total magnification ca 400X; numerical aperture = 0.65 to 0.75.

4. Slides, glass, single-frosted, pre-cleaned, 25 x 75 mm.

5. Cover slips, 25 x 25 mm, no. 1½ unless otherwise specified by microscope manufacturer.

6. Knife, No. 1 surgical steel, curved blade.

7. Tweezers.

8. Flask, Guth-type, insulated neck, 250 to 500 mL (with single-holed rubber stopper and elbow-jointed glass tubing, 16 to 22 cm long).

9. Hotplate, spark-free, stirring type; heating mantle, or infrared lamp and magnetic stirrer.

10. Syringe, hypodermic, with 22-gauge needle.

11. Graticule, Walton-Beckett type with 100 um diameter circular field at the specimen plane (area = 0.00785 mm ²). (Type G-22).

NOTE: the graticule is custom-made for each microscope.

12. HSE/NPL phase contrast test slide, Mark II.

13. Telescope, ocular phase-ring centering.

14. Stage micrometer (0.01 mm divisions).

Sampling

1. Calibrate each personal sampling pump with a representative sampler in line.

2. Fasten the sampler to the worker's lapel as close as possible to the worker's mouth. Remove the top cover from the end of the cowl extension (open face) and orient face down. Wrap the joint between the extender and the monitor's body with shrink tape to prevent air leaks.

3. Submit at least two blanks (or 10% of the total samples, whichever is greater) for each set of samples. Remove the caps from the field blank cassettes and store the caps and cassettes in a clean area (bag or box) during the sampling period. Replace the caps in the cassettes when sampling is completed.

4. Sample at 0.5 L/min or greater. Do not exceed 1 mg total dust loading on the filter. Adjust sampling flow rate, Q (L/min), and time to produce a fiber density, E (fibers/mm²), of 100 to 1300 fibers/mm² [3.85×10^4 to 5×10^5 fibers per 25-mm filter with effective collection area ($A_c = 385$ mm²)] for optimum counting precision (see step 21 below). Calculate the minimum sampling time, $t_{minimum}$ (min) at the action level (one-half of the current standard), L (f/cc) of the fibrous aerosol being sampled:

$$t_{minimum} = \frac{(Ac)(E)}{(Q)(L)10^3}$$

5. Remove the field monitor at the end of sampling, replace the plastic top cover and small end caps, and store the monitor.

6. Ship the samples in a rigid container with sufficient packing material to prevent jostling or damage.

NOTE: Do not use polystyrene foam in the shipping container because of electrostatic forces which may cause fiber loss from the sample filter.

Sample Preparation

NOTE: The object is to produce samples with a smooth (non-grainy) background in a medium with a refractive index equal to or less than 1.46. The method below collapses the filter for easier focusing and produces permanent mounts which are useful for quality control and interlaboratory comparison. Other mounting techniques meeting the above criteria may also be used, e.g., the nonpermanent field mounting technique used in P & CAM 239.

7. Ensure that the glass slides and cover slips are free of dust and fibers.

8. Place 40 to 60 ml of acetone into a Guth-type flask. Stopper the flask with a single-hole rubber stopper through which a glass tube extends 5 to 8 cm into the flask. The portion of the glass tube that exits the top of the stopper (8 to 10 cm) is bent downward in an elbow that makes an angle of 20 to 30 degrees with the horizontal.

9. Place the flask in a stirring hotplate or wrap in a heating mantle. Heat the acetone gradually to its boiling temperature (ca. 58 °C).

CAUTION.—The acetone vapor must be generated in a ventilated fume hood away from all open flames and spark sources. Alternate heating methods can be used, providing no open flame or sparks are present.

10. Mount either the whole sample filter or a wedge cut from the sample filter on a clean glass slide.

a. Cut wedges of ca. 25 percent of the filter area with a curved-blade steel surgical knife using a rocking motion to prevent tearing.

b. Place the filter or wedge, dust side up, on the slide. Static electricity will usually keep the filter on the slide until it is cleared.

c. Hold the glass slide supporting the filter approximately 1 to 2 cm from the glass tube port where the acetone vapor is escaping from the heated flask. The acetone vapor stream should cause a condensation spot on the glass slide ca. 2 to 3 cm in diameter. Move the glass slide gently in the vapor stream. The filter should clear in 2 to 5 sec. If the filter curls, distorts, or is otherwise rendered unusable, the vapor stream is probably not strong enough. Periodically wipe the outlet port with tissue to prevent liquid acetone dripping onto the filter.

d. Using the hypodermic syringe with a 22-gauge needle, place 1 to 2 drops of triacetin on the filter. Gently lower a clean 25-mm square cover slip down onto the filter at a slight angle to reduce the possibility of forming bubbles. If too many bubbles form or the amount of triacetin is insufficient, the cover slip may become detached within a few hours.

e. Glue the edges of the cover slip to the glass slide using a lacquer or nail polish.

NOTE: If clearing is slow, the slide preparation may be heated on a hotplate (surface temperature 50 °C) for 15 min to hasten clearing. Counting may proceed immediately after clearing and mounting are completed.

Calibration and Quality Control

11. Calibration of the Walton-Beckett graticule. The diameter, d_c(mm), of the circular counting area and the disc diameter must be specified when ordering the graticule.

a. Insert any available graticule into the eyepiece and focus so that the graticule lines are sharp and clear.

b. Set the appropriate interpupillary distance and, if applicable, reset the binocular head adjustment so that the magnification remains constant.

c. Install the 40 to 45X phase objective.

d. Place a stage micrometer on the microscope object stage and focus the microscope on the graduated lines.

e. Measure the magnified grid length, L_u(mm), using the stage micrometer.

f. Remove the graticule from the microscope and measure its actual grid length, L_a(mm). This can best be accomplished by using a stage fitted with verniers.

g. Calculate the circle diameter, d_c(mm), for the Walton-Beckett graticule:

$$d_c = \frac{L_a \times D}{L_u}$$

EXAMPLE.—If L_u = 108 um, L_a = 2.93 mm and D = 100 um, then d_c = 2.71 mm.

h. Check the field diameter, D(acceptable range 100 mm ± 2 mm) with a stage micrometer upon receipt of the graticule from the manufacturer. Determine field area (mm^2).

12. Microscope adjustments. Follow the manufacturer's instructions and also the following:

a. Adjust the light source for even illumination across the field of view at the condenser iris.

NOTE: Kohler illumination is preferred, where available.

b. Focus on the particulate material to be examined.

c. Make sure that the field iris is in focus, centered on the sample, and open only enough to fully illuminate the field of view.

d. Use the telescope ocular supplied by the manufacturer to ensure that the phase rings (annular diaphragm and phase-shifting elements) are concentric.

13. Check the phase-shift detection limit of the microscope periodically.

a. Remove the HSE/NPL phase-contrast test slide from its shipping container and center it under the phase objective.

b. Bring the blocks of grooved lines into focus.

NOTE: The slide consists of seven sets of grooves (ca. 20 grooves to each block) in descending order of visibility from sets 1 to 7. The requirements for counting are that the microscope optics must resolve the grooved lines in set 3 completely, although they may appear somewhat faint, and that the grooved lines in sets 6 to 7 must be invisible. Sets 4 and 5 must be at least partially visible but may vary slightly in visibility between microscopes. A microscope which fails to meet these requirements has either too low or too high a resolution to be used for asbestos, tremolite, anthophyllite, and actinolite counting.

c. If the image quality deteriorates, clean the microscope optics and, if the problem persists, consult the microscope manufacturer.

14. Quality control of fiber counts.

a. Prepare and count field blanks along with the field samples. Report the counts on each blank. Calculate the mean of the field blank counts and subtract this value from each sample count before reporting the results.

NOTE 1: The identity of the blank filters should be unknown to the counter until all counts have been completed.

NOTE 2: If a field blank yields greater than 7 fibers/100 fields, possible contamination of the sampl

b. Perform blind recounts by counter on 10 percent of filte (slides relabeled by a person oth counter).

15. Use the following test to whether a pair of counts on the should be rejected because of p This statistic estimates the coun tability at the 95% confidence le the sample if the difference b two counts exceeds 2.77(F F=average of the two fiber s_r=relative standard deviati should be derived by each labor on historical in-house data.

NOTE: If a pair of counts is r result of this test, recount th samples in the set and test the against the first counts. Discard paired counts.

16. Enroll each new counter course that compares perfo counters on a variety of sampl procedure.

NOTE: To ensure good reprod laboratories engaged in asbesto anthophyllite, and actinolite required to participate in the Analytical Testing (PAT) Pr should routinely participate wi bestos, tremolite, anthophyllite lite fiber counting laboratorie change of field samples to c formance of counters.

Measurement

17. Place the slide on the stage of the calibrated microsc center of the filter under the o Focus the microscope on the filter.

18. Regularly check phase-ri and Kohler illumination.

19. The following are the coun

a. Count only fibers longer Measure the length of curved the curve.

b. Count only fibers with width ratio equal to or greater

c. For fibers that cross the the graticule field, do the follo

1. Count any fiber longer th lies entirely within the graticul

2. Count as ½ fiber any fib one end lying within the gratic

3. Do not count any fiber th graticule boundary more than

4. Reject and do not count al

d. Count bundles of fibers unless individual fibers can be observing both ends of a fiber.

e. Count enough graticule f 100 fibers. Count a minimum Stop at 100 fields regardless o

$$d_c = \frac{L_s \times D}{L_n}$$

EXAMPLE.—If L_n = 108 um, L_s = 2.93 mm and D = 100 um, then d_c = 2.71 mm.

h. Check the field diameter, D (acceptable range 100 mm ± 2 mm) with a stage micrometer upon receipt of the graticule from the manufacturer. Determine field area (mm²).

12. Microscope adjustments. Follow the manufacturer's instructions and also the following:

a. Adjust the light source for even illumination across the field of view at the condenser iris.

NOTE: Kohler illumination is preferred, where available.

b. Focus on the particulate material to be examined.

c. Make sure that the field iris is in focus, centered on the sample, and open only enough to fully illuminate the field of view.

d. Use the telescope ocular supplied by the manufacturer to ensure that the phase rings (annular diaphragm and phase-shifting elements) are concentric.

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a. Remove the HSE/NPL phase-contrast test slide from its shipping container and center it under the phase objective.

b. Bring the blocks of grooved lines into focus.

NOTE: The slide consists of seven sets of grooves (ca. 20 grooves to each block) in decreasing order of visibility from sets 1 to 7. The requirements for counting are that the microscope optics must resolve the grooved lines in set 3 completely, although they may appear somewhat faint, and that the grooved lines in sets 6 to 7 must be invisible. Sets 4 and 5 must be at least partially visible but may vary slightly in visibility between microscopes. A microscope which fails to meet these requirements has either too low or too high a resolution to be used for asbestos, tremolite, anthophyllite, and actinolite counting.

. If the image quality deteriorates, clean the microscope optics and, if the problem persists, consult the microscope manufacturer.

4. Quality control of fiber counts.

. Prepare and count field blanks along with the field samples. Report the counts for each blank. Calculate the mean of the field blank counts and subtract this value from each sample count before reporting results.

NOTE 1: The identity of the blank filters should be unknown to the counter until all counts have been completed.

NOTE 2: If a field blank yields fiber counts greater than 7 fibers/100 fields, report possible contamination of the samples.

b. Perform blind recounts by the same counter on 10 percent of filters counted (slides relabeled by a person other than the counter).

15. Use the following test to determine whether a pair of counts on the same filter should be rejected because of possible bias. This statistic estimates the counting repeatability at the 95% confidence level. Discard the sample if the difference between the two counts exceeds 2.77(F)s_r, where F = average of the two fiber counts and s_r = relative standard deviation, which should be derived by each laboratory based on historical in-house data.

NOTE: If a pair of counts is rejected as a result of this test, recount the remaining samples in the set and test the new counts against the first counts. Discard all rejected paired counts.

16. Enroll each new counter in a training course that compares performance of counters on a variety of samples using this procedure.

NOTE: To ensure good reproducibility, all laboratories engaged in asbestos, tremolite, anthophyllite, and actinolite counting are required to participate in the Proficiency Analytical Testing (PAT) Program and should routinely participate with other asbestos, tremolite, anthophyllite, and actinolite fiber counting laboratories in the exchange of field samples to compare performance of counters.

Measurement

17. Place the slide on the mechanical stage of the calibrated microscope with the center of the filter under the objective lens. Focus the microscope on the plane of the filter.

18. Regularly check phase-ring alignment and Kohler illumination.

19. The following are the counting rules:

a. Count only fibers longer than 5 um. Measure the length of curved fibers along the curve.

b. Count only fibers with a length-to-width ratio equal to or greater than 3:1.

c. For fibers that cross the boundary of the graticule field, do the following:

1. Count any fiber longer tha 5 um that lies entirely within the graticule area.

2. Count as ½ fiber any fiber with only one end lying within the graticule area.

3. Do not count any fiber that crosses the graticule boundary more than once.

4. Reject and do not count all other fibers.

d. Count bundles of fibers as one fiber unless individual fibers can be identified by observing both ends of a fiber.

e. Count enough graticule fields to yield 100 fibers. Count a minimum of 20 fields. Stop at 100 fields regardless of fiber count.

20. Start counting from one end of the filter and progress along a radial line to the other end, shift either up or down on the filter, and continue in the reverse direction. Select fields randomly by looking away from the eyepiece briefly while advancing the mechanical stage. When an agglomerate covers ca. ⅛ or more of the field of view, reject the field and select another. Do not report rejected fields in the number of total fields counted.

NOTE: When counting a field, continuously scan a range of focal planes by moving the fine focus knob to detect very fine fibers which have become embedded in the filter. The small-diameter fibers will be very faint but are an important contribution to the total count.

Calculations

21. Calculate and report fiber density on the filter, E (fibers/mm²); by dividing the total fiber count, F; minus the mean field blank count, B, by the number of fields, n; and the field area, A_f (0.00785 mm² for a properly calibrated Walton-Beckett graticule):

$$E = \frac{(F/n_f) - (B/n_b)}{A_f} \text{ fibers/mm}^2$$

where:

n_f = number of fields in submission sample

n_b = number of fields in blank sample

22. Calculate the concentration, C (f/cc), of fibers in the air volume sampled, V (L), using the effective collection area of the filter, A_c (385 mm² for a 25-mm filter):

$$C = \frac{(E)(Ac)}{V(10^3)}$$

NOTE: Periodically check and adjust the value of A_f, if necessary.

APPENDIX C TO § 1910.1001—QUALITATIVE AND QUANTITATIVE FIT TESTING PROCEDURES—MANDATORY

QUALITATIVE FIT TEST PROTOCOLS

I. Isoamyl Acetate Protocol.

A. Odor Threshold Screening

1. Three 1-liter glass jars with metal lids (e.g. Mason or Bell jars) are required.

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2. Odor-free water (e.g. distilled or spring water) at approximately 25 C shall be used for the solutions.

3. The isoamyl acetate (IAA) (also known as isopentyl acetate) stock solution is prepared by adding 1 cc of pure IAA to 800 cc of odor free water in a 1-liter jar and shaking for 30 seconds. This solution shall be prepared new at least weekly.

4. The screening test shall be conducted in a room separate from the room used for actual fit testing. The two rooms shall be well ventilated but shall not be connected to the same recirculating ventilation system.

5. The odor test solution is prepared in a second jar by placing 0.4 cc of the stock solution into 500 cc of odor free water using a clean dropper or pipette. Shake for 30 seconds and allow to stand for two to three minutes so that the IAA concentration above the liquid may reach equilibrium. This solution may be used for only one day.

6. A test blank is prepared in a third jar by adding 500 cc of odor free water.

7. The odor test and test blank jars shall be labelled 1 and 2 for jar identification. If the labels are put on the lids they can be periodically peeled, dried off and switched to maintain the integrity of the test.

8. The following instructions shall be typed on a card and placed on the table in front of the two test jars (i.e. 1 and 2): "The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water. One of these bottles also contains a small amount of banana oil. Be sure the covers are on tight, then shake each bottle for two seconds. Unscrew the lid of each bottle, one at a time, and sniff at the mouth of the bottle. Indicate to the test conductor which bottle contains banana oil."

9. The mixtures used in the IAA odor detection test shall be prepared in an area separate from where the test is performed, in order to prevent olfactory fatigue in the subject.

10. If the test subject is unable to correctly identify the jar containing the odor test solution, the IAA qualitative fit test may not be used.

11. If the test subject correctly identifies the jar containing the odor test solution, the test subject may proceed to respirator selection and fit testing.

B. Respirator Selection

1. The test subject shall be allowed to pick the most comfortable respirator from a selection including respirators of various sizes from different manufacturers. The selection shall include at least five sizes of elastomeric half facepieces, from at least two manufacturers.

2. The selection process shall be conducted in a room separate from the fit-test chamber to prevent odor fatigue. Prior to the selection process, the test subject shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension and how to determine a "comfortable" respirator. A mirror shall be available to assist the subject in evaluating the fit and positioning of the respirator. This instruction may not constitute the subject's formal training on respirator use, as it is only a review.

3. The test subject should understand that the employee is being asked to select the respirator which provides the most comfortable fit. Each respirator represents a different size and shape and, if fit properly and used properly will provide adequate protection.

4. The test subject holds each facepiece up to the face and eliminates those which obviously do not give a comfortable fit. Normally, selection will begin with a half-mask and if a good fit cannot be found, the subject will be asked to test the full facepiece respirators. (A small percentage of users will not be able to wear any half-mask.)

5. The more comfortable facepieces are noted; the most comfortable mask is donned and *worn at least five minutes* to assess comfort. All donning and adjustments of the facepiece shall be performed by the test subject without assistance from the test conductor or other person. Assistance in assessing comfort can be given by discussing the points in #6 below. If the test subject is not familiar with using a particular respirator, the test subject shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper tension on the straps.

6. Assessment of comfort shall include reviewing the following points with the test subject and allowing the test subject adequate time to determine the comfort of the respirator:

- Positioning of mask on nose.
- Room for eye protection.
- Room to talk.
- Positioning mask on face and cheeks.

7. The following criteria shall be used to help determine the adequacy of the respirator fit:

- Chin properly placed.
- Strap tension.
- Fit across nose bridge.
- Distance from nose to chin.
- Tendency to slip.
- Self-observation in mirror.

8. The test subject shall conduct the conventional negative and positive-pressure fit checks (e.g. see ANSI Z88.2-1980). Before conducting the negative- or positive-pressure test the subject shall be told to "seat" the mask by rapidly moving the head from side-to-side and up and down, while taking a few deep breaths.

9. The test subject is now ready for testing.

10. After passing the fit test, the test ject shall be questioned again regarding comfort of the respirator. If it has bec uncomfortable, another model of respir shall be tried.

11. The employee shall be given the portunity to select a different facepiece be retested if the chosen facepiece bec increasingly uncomfortable at any time.

C. Fit Test

1. The fit test chamber shall be simil a clear 55 gal drum liner suspended inv over a 2 foot diameter frame, so that top of the chamber is about 6 inches a the test subject's head. The inside center of the chamber shall have a hook attached.

2. Each respirator used for the fittin fit testing shall be equipped with or vapor cartridges or offer protection a organic vapors. The cartridges or shall be changed at least weekly.

3. After selecting, donning, and pro adjusting a respirator, the test subject wear it to the fit testing room. This shall be separate from the room use odor threshold screening and respirat lection, and shall be well ventilated, an exhaust fan or lab hood, to preven eral room contamination.

4. A copy of the following test exe and rainbow passage shall be taped inside of the test chamber:

Test Exercises

i. Breathe normally.

ii. Breathe deeply. Be certain breat *deep* and *regular*.

iii. Turn head all the way from one the other. Inhale on each side. Be movement is complete. Do not bun respirator against the shoulders.

iv. Nod head up-and-down. Inhale head is in the full up position (toward ceiling). Be certain motions a plete and made about every second. bump the respirator on the chest.

v. Talking. Talk aloud and slowly eral minutes. The following parag called the Rainbow Passage. Readin result in a wide range of facial mov and thus be useful to satisfy this ment. Alternative passages which se same purpose may also be used.

vi. Jogging in place.

vii. Breathe normally.

Rainbow Passage

When the sunlight strikes rain the air, they act like a prism and rainbow. The rainbow is a division light into many beautiful colors. Th the shape of a long round arch.

the selection process. the test subject shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension and how to determine a "comfortable" respirator. A mirror shall be available to assist the subject in evaluating the fit and positioning of the respirator. This instruction may not constitute the subject's formal training on respirator use, as it is only a review.

3. The test subject should understand that the employee is being asked to select the respirator which provides the most comfortable fit. Each respirator represents a different size and shape and, if fit properly and used properly will provide adequate protection.

4. The test subject holds each facepiece up to the face and eliminates those which obviously do not give a comfortable fit. Normally, selection will begin with a half-mask and if a good fit cannot be found, the subject will be asked to test the full facepiece respirators. (A small percentage of users will not be able to wear any half-mask.)

5. The more comfortable facepieces are noted: the most comfortable mask is donned and *worn at least five minutes* to assess comfort. All donning and adjustments of the facepiece shall be performed by the test subject without assistance from the test conductor or other person. Assistance in assuring comfort can be given by discussing [illegible] in #6 below. If the test subject is not familiar with using a particular respirator, the test subject shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper tension on the straps.

6. Assessment of comfort shall include reviewing the following points with the test subject and allowing the test subject adequate time to determine the comfort of the respirator:

Positioning of mask on nose.
Room for eye protection.
Room to talk.
Positioning mask on face and cheeks.

7. The following criteria shall be used to help determine the adequacy of the respirator fit:

Chin properly placed.
Strap tension.
Fit across nose bridge.
Distance from nose to chin.
Tendency to slip.
Self-observation in mirror.

8. The test subject shall conduct the conditional negative and positive-pressure fit checks (e.g. see ANSI Z88.2-1980). Before conducting the negative- or positive-pressure test the subject shall be told to "seat" the mask by rapidly moving the head from side-to-side and up and down, while taking a few deep breaths.

9. The test subject is now ready for fit testing.

10. After passing the fit test, the test subject shall be questioned again regarding the comfort of the respirator. If it has become uncomfortable, another model of respirator shall be tried.

11. The employee shall be given the opportunity to select a different facepiece and be retested if the chosen facepiece becomes increasingly uncomfortable at any time.

C. Fit Test

1. The fit test chamber shall be similar to a clear 55 gal drum liner suspended inverted over a 2 foot diameter frame, so that the top of the chamber is about 6 inches above the test subject's head. The inside top center of the chamber shall have a small hook attached.

2. Each respirator used for the fitting and fit testing shall be equipped with organic vapor cartridges or offer protection against organic vapors. The cartridges or masks shall be changed at least weekly.

3. After selecting, donning, and properly adjusting a respirator, the test subject shall wear it to the fit testing room. This room shall be separate from the room used for odor threshold screening and respirator selection, and shall be well ventilated, as by an exhaust fan or lab hood, to prevent general room contamination.

4. A copy of the following test exercises and rainbow passage shall be taped to the inside of the test chamber:

Test Exercises

i. Breathe normally.

ii. Breathe deeply. Be certain breaths are *deep* and *regular*.

iii. Turn head all the way from one side to the other. Inhale on each side. Be certain movement is complete. Do not bump the respirator against the shoulders.

iv. Nod head up-and-down. Inhale when head is in the full up position (looking toward ceiling). Be certain motions are complete and made about every second. Do not bump the respirator on the chest.

v. Talking. Talk aloud and slowly for several minutes. The following paragraph is called the Rainbow Passage. Reading it will result in a wide range of facial movements, and thus be useful to satisfy this requirement. Alternative passages which serve the same purpose may also be used.

vi. Jogging in place.

vii. Breathe normally.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

5. Each test subject shall wear the respirator for at least 10 minutes before starting the fit test.

6. Upon entering the test chamber, the test subject shall be given a 6 inch by 5 inch piece of paper towel or other porous absorbent single ply material, folded in half and wetted with three-quarters of one cc of pure IAA. The test subject shall hang the wet towel on the hook at the top of the chamber.

7. Allow two minutes for the IAA test concentration to be reached before starting the fit-test exercises. This would be an appropriate time to talk with the test subject, to explain the fit test, the importance of cooperation, the purpose for the head exercises, or to demonstrate some of the exercises.

8. Each exercise described in #4 above shall be performed for at least one minute.

9. If at any time during the test, the subject detects the banana-like odor of IAA, the test has failed. The subject shall quickly exit from the test chamber and leave the test area to avoid olfactory fatigue.

10. If the test is failed, the subject shall return to the selection room and remove the respirator, repeat the odor sensitivity test, select and put on another respirator, return to the test chamber, and again begin the procedure described in the c(4) through c(8) above. The process continues until a respirator that fits well has been found. Should the odor sensitivity test be failed, the subject shall wait about 5 minutes before retesting. Odor sensitivity will usually have returned by this time.

11. If a person cannot pass the fit test described above wearing a half-mask respirator from the available selection, full facepiece models must be used.

12. When a respirator is found that passes the test, the subject breaks the faceseal and takes a breath before exiting the chamber. This is to assure that the reason the test subject is not smelling the IAA is the good fit of the respirator facepiece seal and not olfactory fatigue.

13. When the test subject leaves the chamber, the subject shall remove the saturated towel and return it to the person conducting the test. To keep the area from becoming contaminated, the used towels shall be kept in a self-sealing bag so there is no significant IAA concentration buildup in the test chamber during subsequent tests.

14. At least two facepieces shall be selected for the IAA test protocol. The test subject shall be given the opportunity to wear

Asbestos, Tremolite, Anthophyllite, and Actinolite (29 CFR 1910.1001) (1987)
ACL Doc 21613 · Page 18 of 42
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them for one week to choose the one which is more comfortable to wear.

15. Persons who have successfully passed this fit test with a half-mask respirator may be assigned the use of the test respirator in atmospheres with up to 10 times the PEL of airborne asbestos.

16. The test shall not be conducted if there is any hair growth between the skin the facepiece sealing surface.

17. If hair growth or apparel interfere with a satisfactory fit, then they shall be altered or removed so as to eliminate interference and allow a satisfactory fit. If a satisfactory fit is still not attained, the test subject must use a positive-pressure respirator such as powered air-purifying respirators, supplied air respirator, or self-contained breathing apparatus.

18. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician trained in respirator diseases or pulmonary medicine to determine whether the test subject can wear a respirator while performing her or his duties.

19. Qualitative fit testing shall be repeated at least every six months.

20. In addition, because the sealing of the respirator may be affected, qualitative fit testing shall be repeated immediately when the test subject has a:

(1) Weight change of 20 pounds or more.

(2) Significant facial scarring in the area of the facepiece seal.

(3) Significant dental changes; i.e., multiple extractions without prothesis, or acquiring dentures.

(4) Reconstructive or cosmetic surgery, or

(5) Any other condition that may interfere with facepiece sealing.

D. Recordkeeping

A summary of all test results shall be maintained in each office for 3 years. The summary shall include:

(1) Name of test subject.

(2) Date of testing.

(3) Name of the test conductor.

(4) Respirators selected (indicate manufacturer, model, size and approval number).

(5) Testing agent.

II. Saccharin Solution Aerosol Protocol

A. Respirator Selection

Respirators shall be selected as described in section IB (respirator selection) above, except that each respirator shall be equipped with a particulate filter.

B. Taste Threshold Screening

1. An enclosure about head and shoulders shall be used for threshold screening (to determine if the individual can taste saccharin) and for fit testing. The enclosure shall be approximately 12 inches in diameter by 14 inches tall with at least the front clear to allow free movement of the head when a respirator is worn.

2. The test enclosure shall have a three-quarter inch hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

3. The entire screening and testing procedure shall be explained to the test subject prior to conducting the screening test.

4. During the threshold screening test, the test subject shall don the test enclosure and breathe with open mouth with tongue extended.

5. Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the threshold check solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

6. The threshold check solution consists of 0.83 grams of sodium saccharin, USP in water. It can be prepared by putting 1 cc of the test solution (see C 7 below) in 100 cc of water.

7. To produce the aerosol, the nebulizer bulb is firmly squeezed so that it collapses completely, then is released and allowed to fully expand.

8. Ten squeezes of the nebulizer bulb are repeated rapidly and then the test subject is asked whether the saccharin can be tasted.

9. If the first response is negative, ten more squeezes of the nebulizer bulb are repeated rapidly and the test subject is again asked whether the saccharin can be tasted.

10. If the second response is negative ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin can be tasted.

11. The test conductor will take note of the number of squeezes required to elicit a taste response.

12. If the saccharin is not tasted after 30 squeezes (Step 10), the saccharin fit test cannot be performed on the test subject.

13. If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

14. Correct use of the nebulizer means that approximately 1 cc of liquid is used at a time in the nebulizer body.

15. The nebulizer shall be thoroughly rinsed in water, shaken dry, and refilled at least every four hours.

C. Fit Test

1. The test subject shall don and adjust the respirator without the assistance from any person.

2. The fit test uses the same enclosure described in IIB above.

3. Each test subject shall wear the respirator for at least 10 minutes before starting the fit test.

4. The test subject shall don the enc
while wearing the respirator selected
tion 1B above. This respirator shall be
erly adjusted and equipped with a p
iate filter.

5. The test subject may not eat,
(except plain water), or chew gum
minutes before the test.

6. A second DeVilbiss Model 40 Inh
Medication Nebulizer is used to spray
test solution into the enclosure. Thi
lizer shall be clearly marked to dist
it from the screening test solution ne

7. The fit test solution is prepa
adding 83 grams of sodium saccharir
cc of warm water.

8. As before, the test subject shall
with mouth open and tongue extend

9. The nebulizer is inserted into t
in the front of the enclosure and the
solution is sprayed into the enclosu.
the same technique as for the taste
old screening and the same nur
squeezes required to elicit a taste
in the screening. (See B8 throu
above).

10. After generation of the aero
the following instructions to the
ject. The test subject shall perform
ercises for one minute each.

i. Breathe normally.

ii. Breathe deeply. Be certain bre
deep and *regular*.

iii. Turn head all the way from or
the other. Be certain movement is
Inhale on each side. Do not bump t
rator against the shoulders.

iv. Nod head up-and-down. Be ce
tions are complete. Inhale when h
the full up position (when lookin
the ceiling). Do not bump the resp
the chest.

v. Talking. Talk aloud and slowl
eral minutes. The following par
called the Rainbow Passage. Read
result in a wide range of facial m
and thus be useful to satisfy thi
ment. Alternative passages which
same purpose may also be used.

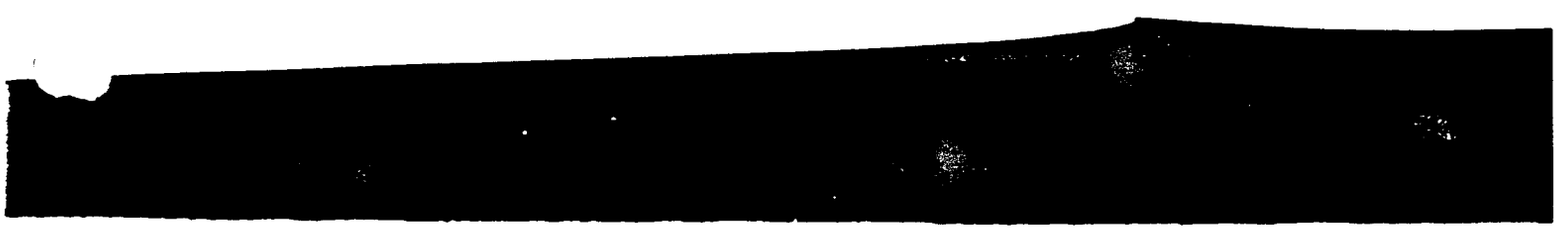
vi. Jogging in place.

vii. Breathe normally.

Rainbow Passage

When the sunlight strikes rai
the air, they act like a prism a
rainbow. The rainbow is a divisio
light into many beautiful colors.
the shape of a long round arch
path high above, and its two ends
ly beyond the horizon. There is,
to legend, a boiling pot of gold
People look, but no one ever finc
a man looks for something t
reach, his friends say he is look
pot of gold at the end of the rain

11. At the beginning of each e
aerosol concentration shall be



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be approximately 12 inches in diameter by 14 inches tall with at least the front clear to allow free movement of the head when a respirator is worn.

2. The test enclosure shall have a three-quarter inch hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

3. The entire screening and testing procedure shall be explained to the test subject prior to conducting the screening test.

4. During the threshold screening test, the test subject shall don the test enclosure and breathe with open mouth with tongue extended.

5. Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the threshold check solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

6. The threshold check solution consists of 83 grams of sodium saccharin, USP in water. It can be prepared by putting 1 cc of the test solution (see C 7 below) in 100 cc of water.

7. To produce the aerosol, the nebulizer bulb is firmly squeezed so that it collapses completely, then is released and allowed to fully expand.

8. Ten squeezes of the nebulizer bulb are repeated rapidly and then the test subject is asked whether the saccharin can be tasted.

If the first response is negative, ten more squeezes of the nebulizer bulb are repeated rapidly and the test subject is again asked whether the saccharin can be tasted.

9. If the second response is negative ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin can be tasted.

10. The test conductor will take note of the number of squeezes required to elicit a response.

11. If the saccharin is not tasted after 30 squeezes (Step 10), the saccharin fit test cannot be performed on the test subject.

If a taste response is elicited, the test subject shall be asked to take note of the response for reference in the fit test.

Correct use of the nebulizer means that approximately 1 cc of liquid is used at a time in the nebulizer body.

The nebulizer shall be thoroughly cleaned in water, shaken dry, and refilled at least every four hours.

C. Fit Test

1. The test subject shall don and adjust the respirator without the assistance from any person.

2. The fit test uses the same enclosure described in IIB above.

3. Each test subject shall wear the respirator at least 10 minutes before starting the test.

4. The test subject shall don the enclosure while wearing the respirator selected in section IB above. This respirator shall be properly adjusted and equipped with a particulate filter.

5. The test subject may not eat, drink (except plain water), or chew gum for 15 minutes before the test.

6. A second DeVilbiss Model 40 Inhalation Medication Nebulizer is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

7. The fit test solution is prepared by adding 83 grams of sodium saccharin to 100 cc of warm water.

8. As before, the test subject shall breathe with mouth open and tongue extended.

9. The nebulizer is inserted into the hole in the front of the enclosure and the fit test solution is sprayed into the enclosure using the same technique as for the taste threshold screening and the same number of squeezes required to elicit a taste response in the screening. (See B8 through B10 above).

10. After generation of the aerosol read the following instructions to the test subject. The test subject shall perform the exercises for one minute each.

i. Breathe normally.

ii. Breathe deeply. Be certain breaths are *deep* and *regular*.

iii. Turn head all the way from one side *to the other*. Be certain movement is complete. Inhale on each side. Do not bump the respirator against the shoulders.

iv. Nod head up-and-down. Be certain motions are complete. Inhale when head is in the full up position (when looking toward the ceiling). Do not bump the respirator on the chest.

v. Talking. Talk aloud and slowly for several minutes. The following paragraph is called the Rainbow Passage. Reading it will result in a wide range of facial movements, and thus be useful to satisfy this requirement. Alternative passages which serve the same purpose may also be used.

vi. Jogging in place.

vii. Breathe normally.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond his reach, his friends say he is looking for the pot of gold at the end of the rainbow.

11. At the beginning of each exercise, the aerosol concentration shall be replenished using one-half the number of squeezes as initially described in C9.

12. The test subject shall indicate to the test conductor if at any time during the fit test the taste of saccharin is detected.

13. If the saccharin is detected the fit is deemed unsatisfactory and a different respirator shall be tried.

14. At least two facepieces shall be selected by the saccharin solution aerosol test protocol. The test subject shall be given the opportunity to wear them for one week to choose the one which is more comfortable to wear.

15. Successful completion of the test protocol shall allow the use of the half mask tested respirator in contaminated atmospheres up to 10 times the PEL of asbestos. In other words this protocol may be used to assign protection factors no higher than ten.

16. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface.

17. If hair growth or apparel interfere with a satisfactory fit, then they shall be altered or removed so as to eliminate interference and allow a satisfactory fit. If a satisfactory fit is still not attained, the test subject must use a positive-pressure respirator such as powered air-purifying respirators, supplied air respirator, or self-contained breathing apparatus.

18. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician trained in respirator diseases or pulmonary medicine to determine whether the test subject can wear a respirator while performing her or his duties.

19. Qualitative fit testing shall be repeated at least every six months.

20. In addition, because the sealing of the respirator may be affected, qualitative fit testing shall be repeated immediately when the test subject has a:

(1) Weight change of 20 pounds or more,

(2) Significant facial scarring in the area of the facepiece seal,

(3) Significant dental changes; i.e.; multiple extractions without prothesis, or acquiring dentures,

(4) Reconstructive or cosmetic surgery, or

(5) Any other condition that may interfere with facepiece sealing.

D. Recordkeeping

A summary of all test results shall be maintained in each office for 3 years. The summary shall include:

(1) Name of test subject.

(2) Date of testing.

(3) Name of test conductor.

(4) Respirators selected (indicate manufacturer, model, size and approval number).

(5) Testing agent.

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III. Irritant Fume Protocol

A. Respirator selection

Respirators shall be selected as described in section IB above, except that each respirator shall be equipped with a high-efficiency cartridge.

B. Fit test

1. The test subject shall be allowed to smell a weak concentration of the irritant smoke to familiarize the subject with the characteristic odor.

2. The test subject shall properly don the respirator selected as above, and wear it for at least 10 minutes before starting the fit test.

3. The test conductor shall review this protocol with the test subject before testing.

4. The test subject shall perform the conventional positive pressure and negative pressure fit checks (see ANSI Z88.2 1980). Failure of either check shall be cause to select an alternate respirator.

5. Break both ends of a ventilation smoke tube containing stannic oxychloride, such as the MSA part =5645, or equivalent. Attach a short length of tubing to one end of the smoke tube. Attach the other end of the smoke tube to a low pressure air pump set to deliver 200 milliliters per minute.

6. Advise the test subject that the smoke can be irritating to the eyes and instruct the subject to keep the eyes closed while the test is performed.

7. The test conductor shall direct the stream of irritant smoke from the tube towards the faceseal area of the test subject. The person conducting the test shall begin with the tube at least 12 inches from the facepiece and gradually move to within one inch, moving around the whole perimeter of the mask.

8. The test subject shall be instructed to do the following exercises while the respirator is being challenged by the smoke. Each exercise shall be performed for one minute.

i. Breathe normally.

ii. Breathe deeply. Be certain breaths are *deep* and *regular*.

iii. Turn head all the way from one side to the other. Be certain movement is complete. Inhale on each side. Do not bump the respirator against the shoulders.

iv. Nod head up-and-down. Be certain motions are complete and made every second. Inhale when head is in the full up position (looking toward ceiling). Do not bump the respirator against the chest.

v. Talking. Talk aloud and slowly for several minutes. The following paragraph is called the Rainbow Passage. Repeating it after the test conductor (keeping eyes closed) will result in a wide range of facial movements, and thus be useful to satisfy this requirement. Alternative passages which serve the same purpose may also be used.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond his reach, his friends say he is looking for the pot of gold at the end of the rainbow.

vi. Jogging in Place.

vii. Breathe normally.

9. The test subject shall indicate to the test conductor if the irritant smoke is detected. If smoke is detected, the test conductor shall stop the test. In this case, the tested respirator is rejected and another respirator shall be selected.

10. Each test subject passing the smoke test (i.e. without detecting the smoke) shall be given a sensitivity check of smoke from the same tube to determine if the test subject reacts to the smoke. Failure to evoke a response shall void the fit test.

11. Steps B4. B9. B10 of this fit test protocol shall be performed in a location with exhaust ventilation sufficient to prevent general contamination of the testing area by the test agents.

12. At least two facepieces shall be selected by the irritant fume test protocol. The test subject shall be given the opportunity to wear them for one week to choose the one which is more comfortable to wear.

13. Respirators successfully tested by the protocol may be used in contaminated atmospheres up to ten times the PEL of asbestos.

14. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface.

15. If hair growth or apparel interfere with a satisfactory fit, then they shall be altered or removed so as to eliminate interference and allow a satisfactory fit. If a satisfactory fit is still not attained, the test subject must use a positive-pressure respirator such as powered air-purifying respirators, supplied air respirator, or self-contained breathing apparatus.

16. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician trained in respirator diseases or pulmonary medicine to determine whether the test subject can wear a respirator while performing her or his duties.

17. Qualitative fit testing shall be repeated at least every six months.

18. In addition, because the sealing
respirator may be affected, qualitati
testing shall be repeated immediately
the test subject has a:

(1) Weight change of 20 pounds or

(2) Significant facial scarring in the
of the facepiece seal.

(3) Significant dental changes, i.e.
ple extractions without prothesis, or
ing dentures.

(4) Reconstructive or cosmestic surg

(5) Any other condition that may
fere with facepiece sealing.

C. Recordkeeping

A summary of all test results sh
maintained in each office for 3 year
summary shall include:

(1) Name of test subject.

(2) Date of testing.

(3) Name of test conductor.

(4) Respirators selected (indicate
facturer, model, size and approval n

(5) Testing agent

Quantitative Fit Test Procedur

1. General.

a. The method applies to the n
pressure nonpowered air-purifying
tors only.

b. The employer shall assign one
ual who shall assume the full respo
for implementing the respirator c
tive fit test program.

2. *Definition.*

a. "Quantitative Fit Test" me
measurement of the effectiveness o
rator seal in excluding the ambien
phere. The test is performed by div
measured concentration of challen
in a test chamber by the measure
tration of the challenge agent ir
respirator facepiece when the no
purifying element has been replac
essentially perfect purifying eleme

b. "Challenge Agent" means th
taminant introduced into a test ch
that its concentration inside and o
respirator may be compared.

c. "Test Subject" means the per
ing the respirator for quantitativ
ing.

d. "Normal Standing Positio
standing erect and straight with
along the sides and looking strai

e. "Fit Factor" means the rati
lenge agent concentration outsid
spect to the inside of a respirato
ering (facepiece or enclosure).

3. *Apparatus.*

a. *Instrumentation.* Corn oil, so
ride or other appropriate aeros
tion, dilution, and measureme
shall be used for quantitative fit

b. *Test chamber.* The test cha
be large enough to permit all t

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which serve the same purpose may also be used.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond his reach, his friends say he is looking for the pot of gold at the end of the rainbow.

vi. Jogging in Place.

vii. Breathe normally.

9. The test subject shall indicate to the test conductor if the irritant smoke is detected. If smoke is detected, the test conductor shall stop the test. In this case, the tested respirator is rejected and another respirator shall be selected.

10. Each test subject passing the smoke test (i.e. without detecting the smoke) shall be given a sensitivity check of smoke from the same tube to determine if the test subject reacts to the smoke. Failure to evoke a response shall void the fit test.

11. Steps B4, B9, B10 of this fit test protocol [illegible] be performed in a location with exhaust ventilation sufficient to prevent general contamination of the testing area by the test agents.

12. At least two facepieces shall be selected by the irritant fume test protocol. The test subject shall be given the opportunity to wear them for one week to choose the one which is more comfortable to wear.

13. Respirators successfully tested by the protocol may be used in contaminated atmospheres up to ten times the PEL of asbestos.

14. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface.

15. If hair growth or apparel interfere with a satisfactory fit, then they shall be altered or removed so as to eliminate interference and allow a satisfactory fit. If a satisfactory fit is still not attained, the test subject must use a positive-pressure respirator such as powered air-purifying respirators, supplied air respirator, or self-contained breathing apparatus.

16. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician trained in respiratory diseases or pulmonary medicine to determine whether the test subject can wear a respirator while performing her or his duties.

17. Qualitative fit testing shall be repeated at least every six months.

18. In addition, because the sealing of the respirator may be affected, qualitative fit testing shall be repeated immediately when the test subject has a:

(1) Weight change of 20 pounds or more.

(2) Significant facial scarring in the area of the facepiece seal.

(3) Significant dental changes; i.e.: multiple extractions without prothesis, or acquiring dentures.

(4) Reconstructive or cosmestic surgery, or

(5) Any other condition that may interfere with facepiece sealing.

C. Recordkeeping

A summary of all test results shall be maintained in each office for 3 years. The summary shall include:

(1) Name of test subject.

(2) Date of testing.

(3) Name of test conductor.

(4) Respirators selected (indicate manufacturer, model, size and approval number).

(5) Testing agent

Quantitative Fit Test Procedures

1. General.

a. The method applies to the negative-pressure nonpowered air-purifying respirators only.

b. The employer shall assign one individual who shall assume the full responsibility for implementing the respirator quantitative fit test program.

2. *Definition.*

a. "Quantitative Fit Test" means the measurement of the effectiveness of a respirator seal in excluding the ambient atmosphere. The test is performed by dividing the measured concentration of challenge agent in a test chamber by the measured concentration of the challenge agent inside the respirator facepiece when the normal air purifying element has been replaced by an essentially perfect purifying element.

b. "Challenge Agent" means the air contaminant introduced into a test chamber so that its concentration inside and outside the respirator may be compared.

c. "Test Subject" means the person wearing the respirator for quantitative fit testing.

d. "Normal Standing Position" means standing erect and straight with arms down along the sides and looking straight ahead.

e. "Fit Factor" means the ratio of challenge agent concentration outside with respect to the inside of a respirator inlet covering (facepiece or enclosure).

3. *Apparatus.*

a. *Instrumentation.* Corn oil, sodium chloride or other appropriate aerosol generation, dilution, and measurement systems shall be used for quantitative fit test.

b. *Test chamber.* The test chamber shall be large enough to permit all test subjects to freely perform all required exercises without distributing the challenge agent concentration or the measurement apparatus. The test chamber shall be equipped and constructed so that the challenge agent is effectively isolated from the ambient air yet uniform in concentration throughout the chamber.

c. When testing air-purifying respirators, the normal filter or cartridge element shall be replaced with a high-efficiency particulate filter supplied by the same manufacturer.

d. The sampling instrument shall be selected so that a strip chart record may be made of the test showing the rise and fall of challenge agent concentration with each inspiration and expiration at fit factors of at least 2,000.

e. The combination of substitute air-purifying elements (if any), challenge agent, and challenge agent concentration in the test chamber shall be such that the test subject is not exposed in excess of PEL to the challenge agent at any time during the testing process.

f. The sampling port on the test specimen respirator shall be placed and constructed so that there is no detectable leak around the port, a free air flow is allowed into the sampling line at all times and so there is no interference with the fit or performance of the respirator.

g. The test chamber and test set-up shall permit the person administering the test to observe one test subject inside the chamber during the test.

h. The equipment generating the challenge atmosphere shall maintain the concentration of challenge agent constant within a 10 percent variation for the duration of the test.

i. The time lag (interval between an event and its being recorded on the strip chart) of the instrumentation may not exceed 2 seconds.

j. The tubing for the test chamber atmosphere and for the respirator sampling port shall be the same diameter, length and material. It shall be kept as short as possible. The smallest diameter tubing recommended by the manufacturer shall be used.

k. The exhaust flow from the test chamber shall pass through a high-efficiency filter before release to the room.

l. When sodium chloride aerosol is used, the relative humidity inside the test chamber shall not exceed 50 percent.

4. *Procedural Requirements.*

a. The fitting of half-mask respirators should be started with those having multiple sizes and a variety of interchangeable cartridges and canisters such as the MSA Comfo II-M, North M, Survivair M, A-O M, or Scott-M. Use either of the tests outlined

below to assure that the facepiece is properly adjusted.

(1) *Positive pressure test.* With the exhaust port(s) blocked, the negative pressure of slight inhalation should remain constant for several seconds.

(2) *Negative pressure test.* With the intake port(s) blocked, the negative pressure slight inhalation should remain constant for several seconds.

b. After a facepiece is adjusted, the test subject shall wear the facepiece for at least 5 minutes before conducting a qualitive test by using either of the methods described below and using the exercise regime described in 5.a., b., c., d, and e.

(1) *Isoamyl acetate test.* When using organic vapor cartridges, the test subject who can smell the odor should be unable to detect the odor of isoamyl acetate squirted into the air near the most vulnerable portions of the facepiece seal. In a location which is separated from the test area, the test subject shall be instructed to close her/his eyes during the test period. A combination cartridge or canister with organic vapor and high-efficiency filters shall be used when available for the particular mask being tested. The test subject shall be given an opportunity to smell the odor of isoamyl acetate before the test is conducted.

(2) *Irritant fume test.* When using high-efficiency filters, the test subject should be unable to detect the odor of irritant fume (stannic chloride or titanium tetrachloride ventilation smoke tubes) squirted into the air near the most vulnerable portions of the facepiece seal. The test subject shall be instructed to close her/his eyes during the test period.

c. The test subject may enter the quantitative testing chamber only if she or he has obtained a satisfactory fit as stated in 4.b. of this Appendix.

d. Before the subject enters the test chamber, a reasonably stable challenge agent concentration shall be measured in the test chamber.

e. Immediately after the subject enters the test chamber, the challenge agent concentration inside the respirator shall be measured to ensure that the peak penetration does not exceed 5 percent for a half-mask and 1 percent for a full facepiece.

f. A stable challenge agent concentration shall be obtained prior to the actual start of testing.

(1) Respirator restraining straps may not be overtightened for testing. The straps shall be adjusted by the wearer to give a reasonably comfortable fit typical of normal use.

5. *Exercise Regime.* Prior to entering the test chamber, the test subject shall be given complete instructions as to her/his part in the test procedures. The test subject shall perform the following exercises, in the order given, for each independent test.

a. *Normal Breathing (NB).* In the normal standing position, without talking, the subject shall breathe normally for at least one minute.

b. *Deep Breathing (DB).* In the normal standing position the subject shall do deep breathing for at least one minute pausing so as not to hyperventilate.

c. *Turning head side to side (SS).* Standing in place the subject shall slowly turn his/her head from side between the extreme positions to each side. The head shall be held at each extreme position for at least 5 seconds. Perform for at least three complete cycles.

d. *Moving head up and down (UD).* Standing in place, the subject shall slowly move his/her head up and down between the extreme position straight up and the extreme position straight down. The head shall be held at each extreme position for at least 5 seconds. Perform for at least three complete cycles.

e. *Reading (R).* The test subject (keeping eyes closed) shall repeat after the test conductor the 'rainbow passage' at the end of this section. The subject shall talk slowly and aloud so as to be heard clearly by the test conductor or monitor.

f. *Grimace (G).* The test subject shall grimace, smile, frown, and generally contort the face using the facial muscles. Continue for at least 15 seconds.

g. *Bend over and touch toes (B).* The test subject shall bend at the waist and touch toes and return to upright position. Repeat for at least 30 seconds.

h. *Jogging in place (J).* The test subject shall perform jog in place for at least 30 seconds.

i. *Normal Breathing (NB).* Same as exercise a.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

6. The test shall be terminated whenever any single peak penetration exceeds 5 percent for half-masks and 1 percent for full facepieces. The test subject may be refitted and retested. If two of the three required tests are terminated, the fit shall be deemed inadequate.

7. *Calculation of Fit Factors.*

a. The fit factor determined b
titative fit test equals the aver
tration inside the respirator.

b. The average test chamber
tion is the arithmetic average
chamber concentration at the
and of the end of the test.

c. The average peak concentr
challenge agent inside the resp
be the arithmetic average peak
tions for each of the nine exer
test which are computed as th
average of the peak concentra
for each breath during the exer

d. The average peak concentr
exercise may be determined g
there is not a great variation
concentrations during a single e

8. *Interpretation of Test Res*
factor measured by the quantit
ing shall be the lowest of the
tion factors resulting from thr
ent tests.

9. *Other Requirements.*

a. The test subject shall not
to wear a half-mask or full face
the minimum fit factor of 10
spectively, cannot be obtai
growth or apparel interfere w
tory fit, then they shall be
moved so as to eliminate int
allow a satisfactory fit. If a s
is still not attained, the test
use a positive-pressure respi
powered air-purifying respira
air respirator, or self-contai
apparatus.

b. The test shall not be conc
is any hair growth between th
facepiece sealing surface.

c. If a test subject exhibit
breathing during the tests, s
be referred to a physician trai
tor diseases or pulmonary me
mine whether the test subje
respirator while performin
duties.

d. The test subject shall b
portunity to wear the assig
for one week. If the respirato
vide a satisfactory fit during
test subject may request
which shall be performed imm

e. A respirator fit factor
issued to the test subject wit
information:

(1) Name.

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perform the following exercises, in the order given, for each independent test.

a. *Normal Breathing (NB).* In the normal standing position, without talking, the subject shall breathe normally for at least one minute.

b. *Deep Breathing (DB).* In the normal standing position the subject shall do deep breathing for at least one minute pausing so as not to hyperventilate.

c. *Turning head side to side (SS).* Standing in place the subject shall slowly turn his/her head from side between the extreme positions to each side. The head shall be held in each extreme position for at least 5 seconds. Perform for at least three complete cycles.

d. *Moving head up and down (UD).* Standing in place, the subject shall slowly move his/her head up and down between the extreme position straight up and the extreme position straight down. The head shall be held at each extreme position for at least 5 seconds. Perform for at least three complete cycles.

Reading (R). The test subject (keeping eyes closed) shall repeat after the test conductor the 'rainbow passage' at the end of this section. The subject shall talk slowly and aloud so as to be heard clearly by the test conductor or monitor.

Grimace (G). The test subject shall make a facial grimace, frown, and generally contort the face using the facial muscles. Continue for at least 15 seconds.

Bend over and touch toes (B). The test subject shall bend at the waist and touch toes and return to upright position. Repeat for at least 30 seconds.

Jogging in place (J). The test subject shall perform jog in place for at least 30 seconds.

Normal Breathing (NB). Same as exercise 1.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

The test shall be terminated whenever any single peak penetration exceeds 5 percent for half-masks and 1 percent for full facepieces. The test subject may be refitted and retested. If two of the three required tests be terminated, the fit shall be deemed inadequate.

Calculation of Fit Factors.

a. The fit factor determined by the quantitative fit test equals the average concentration inside the respirator.

b. The average test chamber concentration is the arithmetic average of the test chamber concentration at the beginning and of the end of the test.

c. The average peak concentration of the challenge agent inside the respirator shall be the arithmetic average peak concentrations for each of the nine exercises of the test which are computed as the arithmetic average of the peak concentrations found for each breath during the exercise.

d. The average peak concentration for an exercise may be determined graphically if there is not a great variation in the peak concentrations during a single exercise.

8. *Interpretation of Test Results.* The fit factor measured by the quantitative fit testing shall be the lowest of the three protection factors resulting from three independent tests.

9. *Other Requirements.*

a. The test subject shall not be permitted to wear a half-mask or full facepiece mask if the minimum fit factor of 100 or 1,000, respectively, cannot be obtained. If hair growth or apparel interfere with a satisfactory fit, then they shall be altered or removed so as to eliminate interference and allow a satisfactory fit. If a satisfactory fit is still not attained, the test subject must use a positive-pressure respirator such as powered air-purifying respirators, supplied air respirator, or self-contained breathing apparatus.

b. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface.

c. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician trained in respirator diseases or pulmonary medicine to determine whether the test subject can wear a respirator while performing her or his duties.

d. The test subject shall be given the opportunity to wear the assigned respirator for one week. If the respirator does not provide a satisfactory fit during actual use, the test subject may request another QNFT which shall be performed immediately.

e. A respirator fit factor card shall be issued to the test subject with the following information:

(1) Name.

(2) Date of fit test.

(3) Protection factors obtained through each manufacturer, model and approval number of respirator tested.

(4) Name and signature of the person that conducted the test.

f. Filters used for qualitative or quantitative fit testing shall be replaced weekly, whenever increased breathing resistance is encountered, or when the test agent has altered the integrity of the filter media. Organic vapor cartridges/canisters shall be replaced daily or sooner if there is any indication of breakthrough by the test agent.

10. In addition, because the sealing of the respirator may be affected, quantitative fit testing shall be repeated immediately when the test subject has a:

(1) Weight change of 20 pounds or more,

(2) Significant facial scarring in the area of the facepiece seal,

(3) Significant dental changes; i.e., multiple extractions without prothesis, or acquiring dentures,

(4) Reconstructive or cosmetic surgery, or

(5) Any other condition that may interfere with facepiece sealing.

11. *Recordkeeping.*

A summary of all test results shall be maintained for 3 years. The summary shall include:

(1) Name of test subject.

(2) Date of testing.

(3) Name of the test conductor.

(4) Fit factors obtained from every respirator tested (indicate manufacturer, model, size and approval number).

Appendix D to § 1910.1001—Medical Questionnaires: Mandatory

This mandatory appendix contains the medical questionnaires that must be administered to all employees who are exposed to asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals above the action level, and who will therefore be included in their employer's medical surveillance program. Part 1 of the appendix contains the Initial Medical Questionnaire, which must be obtained for all new hires who will be covered by the medical surveillance requirements. Part 2 includes the abbreviated Periodical Medical Questionnaire, which must be administered to all employees who are provided periodic medical examinations under the medical surveillance provisions of the standard.

Asbestos, Tremolite, Anthophyllite, and Actinolite (29 CFR 1910.1001) (1987)
ACL Doc 21613 · Page 24 of 42
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Part I
INITIAL MEDICAL QUESTIONNAIRE

1. NAME _____

2. SOCIAL SECURITY # ___ ___ ___ ___ ___ ___ ___ ___ ___
(1 2 3 4 5 6 7 8 9)

3. CLOCK NUMBER ___ ___ ___ ___ ___ ___
(10 11 12 13 14 15)

4. PRESENT OCCUPATION _____

5. PLANT _____

6. ADDRESS _____

7. _____
(Zip Code)

8. TELEPHONE NUMBER _____

9. INTERVIEWER _____

10. DATE _____ ___ ___ ___ ___ ___ ___
(16 17 18 19 20 21)

11. Date of Birth _____ ___ ___ ___ ___ ___ ___
Month Day Year (22 23 24 25 26 27)

12. Place of Birth _____

13. Sex
1. Male ___
2. Female ___

14. What is your marital status?
1. Single ___
2. Married ___
3. Widowed ___
4. Separated/ Divorced ___

15. Race
1. White ___
2. Black ___
3. Asian ___
4. Hispanic ___
5. Indian ___
6. Other ___

16. What is the highest grade completed in school? _____
(For example 12 years is completion of high school)

OCCUPATIONAL HISTORY

17A. Have you ever worked full time (30 hours per week or more) for 6 months or more?
1. Yes ___ 2. No ___

IF YES TO 17A:

B. Have you ever worked for a year or more in any dusty job?
1. Yes ___ 2. No ___
3. Does Not Apply ___

Specify job/industry ____

Was dust exposure: 1. Mild

C. Have you ever been exposed chemical fumes in your wor
Specify job/industry ____

Was exposure: 1. Mild

D. What has been your usual worked at the longest?

1. Job occupation _____

2. Number of years employ

3. Position/job title ___

4. Business, field or industry ___

(Record on lines the years in industries, e.g. 1960-1969)

Have you ever worked:

E. In a mine?.....

F. In a quarry?.....

G. In a foundry?.....

H. In a pottery?.....

I. In a cotton, flax or h

J. With asbestos?.....

18. PAST MEDICAL HISTORY

A. Do you consider yourself

If "NO" state reason

B. Have you any defect of v

If "YES" state natur

C. Have you any hearing def

If "YES" state natu

1
QUESTIONNAIRE

5 6 7 8 9

11 12 13 14 15

ip Code)

17 18 19 20 21

23 24 25 26 27

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rried
owed

4. Separated/
Divorced

te
ck
an

4. Hispanic
5. Indian
6. Other

school?
high school)

urs
e?

1. Yes 2. No

re in

1. Yes 2. No
3. Does Not Apply

Specify job/industry _____ Total Years Worked ___

Was dust exposure: 1. Mild ___ 2. Moderate ___ 3. Severe ___

C. Have you ever been exposed to gas or chemical fumes in your work? 1. Yes ___ 2. No ___
Specify job/industry _____ Total Years Worked ___

Was exposure: 1. Mild ___ 2. Moderate ___ 3. Severe ___

D. What has been your usual occupation or job--the one you have worked at the longest?

1. Job occupation _____

2. Number of years employed in this occupation _____

3. Position/job title _____

4. Business, field or industry _____

(Record on lines the years in which you have worked in any of these industries, e.g. 1960-1969)

Have you ever worked:

	YES	NO
E. In a mine?.....	[__]	[__]
F. In a quarry?.....	[__]	[__]
G. In a foundry?.....	[__]	[__]
H. In a pottery?.....	[__]	[__]
I. In a cotton, flax or hemp mill?.....	[__]	[__]
J. With asbestos?.....	[__]	[__]

18. PAST MEDICAL HISTORY

	YES	NO
A. Do you consider yourself to be in good health?	[__]	[__]
If "NO" state reason _____		
B. Have you any defect of vision?.....	[__]	[__]
If "YES" state nature of defect _____		
C. Have you any hearing defect?.....	[__]	[__]
If "YES" state nature of defect _____		

D. Are you suffering from or have you ever suffered from:

a. Epilepsy (or fits, seizures, convulsions)? [__] [__]

b. Rheumatic fever? [__] [__]

c. Kidney disease? [__] [__]

d. Bladder disease? [__] [__]

e. Diabetes? [__] [__]

f. Jaundice? [__] [__]

19. CHEST COLDS AND CHEST ILLNESSES

19A. If you get a cold, does it usually go to your chest? (Usually means more than 1/2 the time) 1. Yes __ 2. No __ 3. Don't get colds __

20A. During the past 3 years, have you had any chest illnesses that have kept you off work, indoors at home, or in bed? 1. Yes __ 2. No __

IF YES TO 20A:

B. Did you produce phlegm with any of these chest illnesses? 1. Yes __ 2. No __ 3. Does Not Apply __

C. In the last 3 years, how many such illnesses with (increased) phlegm did you have which lasted a week or more? Number of illnesses __ No such illnesses __

21. Did you have any lung trouble before the age of 16? 1. Yes __ 2. No __

22. Have you ever had any of the following?

1A. Attacks of bronchitis? 1. Yes __ 2. No __

IF YES TO 1A:

B. Was it confirmed by a doctor? 1. Yes __ 2. No __ 3. Does Not Apply __

C. At what age was your first attack? Age in Years __ Does Not Apply __

2A. Pneumonia (include bronchopneumonia)? 1. Yes __ 2. No __

IF YES TO 2A:

B. Was it confirmed by a doctor? 1. Yes __ 2. No __ 3. Does Not Apply __

C. At what age did you first have it? Age in Years __ Does Not Apply __

3A. Hay Fever?

IF YES TO 3A:

B. Was it confirmed

C. At what age did

23A. Have you ever had ch

IF YES TO 23A:

B. Do you still have it

C. Was it confirmed by

D. At what age did it

24A. Have you ever had e

IF YES TO 24A:

B. Do you still have i

C. Was it confirmed by

D. At what age did it

25A. Have you ever had a

IF YES TO 25A:

B. Do you still have

C. Was it confirmed b

D. At what age did it

E. If you no longer h stop?

26. Have you ever had:

A. Any other chest il

If yes, please

ever suffered from:

onvulsions)? [ ] [ ]
[ ] [ ]
[ ] [ ]
[ ] [ ]
[ ] [ ]
[ ] [ ]

go to your 1. Yes __ 2. No __
the time) 3. Don't get colds __

had any chest 1. Yes __ 2. No __
ork, indoors at

these chest 1. Yes __ 2. No __
3. Does Not Apply __

illnesses Number of illnesses __
e which No such illnesses __

e the age of 1. Yes __ 2. No __

ving(

1. Yes __ 2. No __

1. Yes __ 2. No __
3. Does Not Apply __

ck? Age in Years __
Does Not Apply __

onia)? 1. Yes __ 2. No __

1. Yes __ 2. No __
3. Does Not Apply __

it? Age in Years __
Does Not Apply __

3A. Hay Fever? 1. Yes __ 2. No __

IF YES TO 3A:
B. Was it confirmed by a doctor? 1. Yes __ 2. No __ 3. Does Not Apply __

C. At what age did it start? Age in Years __ Does Not Apply __

23A. Have you ever had chronic bronchitis? 1. Yes __ 2. No __

IF YES TO 23A:
B. Do you still have it? 1. Yes __ 2. No __ 3. Does Not Apply __

C. Was it confirmed by a doctor? 1. Yes __ 2. No __ 3. Does Not Apply __

D. At what age did it start? Age in Years __ Does Not Apply __

24A. Have you ever had emphysema? 1. Yes __ 2. No __

IF YES TO 24A:
B. Do you still have it? 1. Yes __ 2. No __ 3. Does Not Apply __

C. Was it confirmed by a doctor? 1. Yes __ 2. No __ 3. Does Not Apply __

D. At what age did it start? Age in Years __ Does Not Apply __

25A. Have you ever had asthma? 1. Yes __ 2. No __

IF YES TO 25A:
B. Do you still have it? 1. Yes __ 2. No __ 3. Does Not Apply __

C. Was it confirmed by a doctor? 1. Yes __ 2. No __ 3. Does Not Apply __

D. At what age did it start? Age in Years __ Does Not Apply __

E. If you no longer have it, at what age did it stop? Age stopped __ Does Not Apply __

26. Have you ever had:

A. Any other chest illness? 1. Yes __ 2. No __

If yes, please specify _____

B. Any chest operations? 1. Yes __ 2. No __

If yes, please specify _____

C. Any chest injuries? 1. Yes __ 2. No __

If yes, please specify _____

27A. Has a doctor ever told you that you had heart trouble? 1. Yes __ 2. No __

IF YES TO 27A:

B. Have you ever had treatment for heart trouble in the past 10 years? 1. Yes __ 2. No __ 3. Does Not Apply __

28A. Has a doctor ever told you that you had high blood pressure? 1. Yes __ 2. No __

IF YES TO 28A:

B. Have you had any treatment for high blood pressure (hypertension) in the past 10 years? 1. Yes __ 2. No __ 3. Does Not Apply __

29. When did you last have your chest X-rayed? (Year) $\overline{25}$ $\overline{26}$ $\overline{27}$ $\overline{28}$

30. Where did you last have your chest X-rayed (if known)? _____

What was the outcome? _____

FAMILY HISTORY

31. Were either of your natural parents ever told by a doctor that they had a chronic lung condition such as:

	FATHER 1. Yes	2. No	3. Don't Know	MOTHER 1. Yes	2. No	3. Don't Know
A. Chronic Bronchitis?	__	__	__	__	__	__
B. Emphysema?	__	__	__	__	__	__
C. Asthma?	__	__	__	__	__	__
D. Lung cancer?	__	__	__	__	__	__
E. Other chest conditions	__	__	__	__	__	__
F. Is parent currently alive?	__	__	__	__	__	__
G. Please Specify	__ Age if Living __ Age at Death __ Don't Know			__ Age if Living __ Age at Death __ Don't Know		

H. Please specify cause

COUGH

32A. Do you usually have a a cough with first smo going out of doors. (of throat.) (If no, s 32C.)

B. Do you usually cough 6 times a day 4 or mo the week?

C. Do you usually cough up or first thing in

D. Do you usually cough rest of the day or at

IF YES TO ANY OF ABOVE (32. TO ALL, CHECK DOES NOT APP

E. Do you usually cough days for 3 consecutiv during the year?

F. For how many years ha

33A. Do you usually bring chest? (Count phlegm with th on first going out of phlegm from the nose. phlegm.) (If no, ski

B. Do you usually bring as much as twice a da out of the week?

C. Do you usually bring getting up or first t

D. Do you usually bring during the rest of th

IF YES TO ANY OF THE ABOVE IF NO TO ALL, CHECK DOES N

E. Do you bring up phleg days for 3 consecutiv during the year?

1. Yes __ 2. No __

1. Yes __ 2. No __

d had heart 1. Yes __ 2. No __

art trouble 1. Yes __ 2. No __
3. Does Not Apply __

d had high 1. Yes __ 2. No __

n blood 1. Yes __ 2. No __
t 10 years? 3. Does Not Apply __

X-rayed? (Year) 25 26 27 28

X rayed (if known)? _____

ever told by a doctor that they had a

	MOTHER		
Don't Know	1. Yes	2. No	3. Don't Know
__	__	__	__
__	__	__	__
__	__	__	__
__	__	__	__
__	__	__	__
__	__	__	__

__ Age if Living
__ Age at Death
__ Don't Know

Please specify cause of death _____ _____

32A. Do you usually have a cough? (Count a cough with first smoke or on first going out of doors. Exclude clearing of throat.) (If no, skip to question 33C.) 1. Yes __ 2. No __

B. Do you usually cough as much as 4 to 6 times a day 4 or more days out of the week? 1. Yes __ 2. No __

C. Do you usually cough at all on getting up or first thing in the morning? 1. Yes __ 2. No __

D. Do you usually cough at all during the rest of the day or at night? 1. Yes __ 2. No __

IF YES TO ANY OF ABOVE (32A, B, C, or D), ANSWER THE FOLLOWING. IF NO TO ALL, CHECK DOES NOT APPLY AND SKIP TO NEXT PAGE

E. Do you usually cough like this on most days for 3 consecutive months or more during the year? 1. Yes __ 2. No __ 3. Does not apply __

F. For how many years have you had the cough? Number of years __ Does not apply __

33A. Do you usually bring up phlegm from your chest? (Count phlegm with the first smoke or on first going out of doors. Exclude phlegm from the nose. Count swallowed phlegm.) (If no, skip to 33C) 1. Yes __ 2. No __

B. Do you usually bring up phlegm like this as much as twice a day 4 or more days out of the week? 1. Yes __ 2. No __

C. Do you usually bring up phlegm at all on getting up or first thing in the morning? 1. Yes __ 2. No __

D. Do you usually bring up phlegm at all during the rest of the day or at night? 1. Yes __ 2. No __

IF YES TO ANY OF THE ABOVE (33A, B, C, or D), ANSWER THE FOLLOWING: IF NO TO ALL, CHECK DOES NOT APPLY AND SKIP TO 34A.

E. Do you bring up phlegm like this on most days for 3 consecutive months or more during the year? 1. Yes __ 2. No __ 3. Does not apply __

F. For how many years have you had trouble with phlegm? — Number of years ___ Does not apply ___

EPISODES OF COUGH AND PHLEGM

34A. Have you had periods or episodes of (increased*) cough and phlegm lasting for 3 weeks or more each year? *(For persons who usually have cough and/or phlegm) — 1. Yes ___ 2. No ___

If YES TO 34A

B. For how long have you had at least 1 such episode per year? — Number of years ___ Does not apply ___

WHEEZING

35A. Does your chest ever sound wheezy or whistling

1. When you have a cold? — 1. Yes ___ 2. No ___
2. Occasionally apart from colds? — 1. Yes ___ 2. No ___
3. Most days or nights? — 1. Yes ___ 2. No ___

IF YES TO 1, 2, or 3 in 35A

B. For how many years has this been present? — Number of years ___ Does not apply ___

36A. Have you ever had an attack of wheezing that has made you feel short of breath? — 1. Yes ___ 2. No ___

IF YES TO 36A

B. How old were you when you had your first such attack? — Age in years ___ Does not apply ___

C. Have you had 2 or more such episodes? — 1. Yes ___ 2. No ___ 3. Does not apply ___

D. Have you ever required medicine or treatment for the(se) attack(s)? — 1. Yes ___ 2. No ___ 3. Does not apply ___

BREATHLESSNESS

37. If disabled from walking by any condition other than heart or lung disease, please describe and proceed to question 39A. Nature of condition(s)_____

38A. Are you troubled by shortness of breath when hurrying on the level or walking up a slight hill? — 1. Yes ___ 2. No ___

IF YES TO 38A

B. Do you have to walk slower th your age on the level because lessness?

C. Do you ever have to stop for walking at your own pace on t

D. Do you ever have to stop for after walking about 100 yards after a few minutes, on the l

E. Are you too breathless to lea house or breathless on dress climbing one flight of stairs

TOBACCO SMOKING

39A. Have you ever smoked cigarett means less than 20 packs of c or 12 oz. of tobacco in a lif than 1 cigarette a day for 1

IF YES TO 39A

B. Do you now smoke cigarettes (one month ago)

C. How old were you when you fir regular cigarette smoking?

D. If you have stopped smoking c completely, how old were you stopped?

E. How many cigarettes do you sm day now?

F. On the average of the entire smoked, how many cigarettes d smoke per day?

G. Do or did you inhale the ciga

40A. Have you ever smoked a pipe r (Yes means more than 12 oz. o in a lifetime.)

trouble

Number of years ___
Does not apply ___

s of (in- ing for 3 — 1. Yes ___ 2. No ___

cough and/or

ast 1 such

Number of years ___
Does not apply ___

y or

d? — 1. Yes ___ 2. No ___
from colds? — 1. Yes ___ 2. No ___
? — 1. Yes ___ 2. No ___

present?

Number of years ___
Does not apply ___

neezing — 1. Yes ___ 2. No ___
breath?

ar first

Age in years ___
Does not apply ___

dr (— 1. Yes ___ 2. No ___
3. Does not apply ___

r — 1. Yes ___ 2. No ___
3. Does not apply ___

ondition
please
39A.

breath when — 1. Yes ___ 2. No ___
p a

IF YES TO 38A

B. Do you have to walk slower than people of your age on the level because of breathlessness? — 1. Yes ___ 2. No ___ 3. Does not apply ___

C. Do you ever have to stop for breath when walking at your own pace on the level? — 1. Yes ___ 2. No ___ 3. Does not apply ___

D. Do you ever have to stop for breath after walking about 100 yards (or after a few minutes) on the level? — 1. Yes ___ 2. No ___ 3. Does not apply ___

E. Are you too breathless to leave the house or breathless on dressing or climbing one flight of stairs? — 1. Yes ___ 2. No ___ 3. Does not apply ___

TOBACCO SMOKING

39A. Have you ever smoked cigarettes? (No means less than 20 packs of cigarettes or 12 oz. of tobacco in a lifetime or less than 1 cigarette a day for 1 year.) — 1. Yes ___ 2. No ___

IF YES TO 39A

B. Do you now smoke cigarettes (as of one month ago) — 1. Yes ___ 2. No ___ 3. Does not apply ___

C. How old were you when you first started regular cigarette smoking? — Age in years ___ Does not apply ___

D. If you have stopped smoking cigarettes completely, how old were you when you stopped? — Age stopped ___ Check if still smoking ___ Does not apply ___

E. How many cigarettes do you smoke per day now? — Cigarettes per day ___ Does not apply ___

F. On the average of the entire time you smoked, how many cigarettes did you smoke per day? — Cigarettes per day ___ Does not apply ___

G. Do or did you inhale the cigarette smoke? — 1. Does not apply ___ 2. Not at all ___ 3. Slightly ___ 4. Moderately ___ 5. Deeply ___

40A. Have you ever smoked a pipe regularly? (Yes means more than 12 oz. of tobacco in a lifetime.) — 1. Yes ___ 2. No ___

IF YES TO 40A:
FOR PERSONS WHO HAVE EVER SMOKED A PIPE

B. 1. How old were you when you started to smoke a pipe regularly? — Age __

2. If you have stopped smoking a pipe completely, how old were you when you stopped? — Age stopped __; Check if still smoking pipe __; Does not apply __

C. On the average over the entire time you smoked a pipe, how much pipe tobacco did you smoke per week? — __ oz. per week (a standard pouch of tobacco contains 1 1/2 oz.); __ Does not apply

D. How much pipe tobacco are you smoking now? — oz. per week __; Not currently smoking a pipe __

E. Do you or did you inhale the pipe smoke? — 1. Never smoked __; 2. Not at all __; 3. Slightly __; 4. Moderately __; 5. Deeply __

41A. Have you ever smoked cigars regularly? (Yes means more than 1 cigar a week for a year) — 1. Yes __ 2. No __

IF YES TO 41A
FOR PERSONS WHO HAVE EVER SMOKED CIGARS

B. 1. How old were you when you started smoking cigars regularly? — Age __

2. If you have stopped smoking cigars completely, how old were you when you stopped. — Age stopped __; Check if still smoking cigars __; Does not apply __

C. On the average over the entire time you smoked cigars, how many cigars did you smoke per week? — Cigars per week __; Does not apply __

D. How many cigars are you smoking per week now? — Cigars per week __; Check if not smoking cigars currently __

E. Do or did you inhale the cigar smoke? — 1. Never smoked __; 2. Not at all __; 3. Slightly __; 4. Moderately __; 5. Deeply __

Signature _____ Date _____

1. NAME _____
2. SOCIAL SECURITY # _
3. CLOCK NUMBER
4. PRESENT OCCUPATION _
5. PLANT _____
6. ADDRESS _____
7. _____
8. TELEPHONE NUMBER ___
9. INTERVIEWER _____
10. DATE _____
11. What is your marital
12. OCCUPATIONAL HISTORY
12A. In the past year, di full time (30 hours or more) for 6 month

IF YES TO 12A:

12B. In the past year, di in a dusty job?
12C. Was dust exposure:
12D. In the past year, we exposed to gas or ch fumes in your work?
12E. Was exposure:
12F. In the past year, what was your:

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to

Age __

Age stopped
you Check if still smoking pipe __
Does not apply __

ou __ oz. per week (a standard
did pouch of tobacco contains 1 1/2 oz.)
__ Does not apply

now? oz. per week __
Not currently smoking a pipe __

ke?
1. Never smoked __
2. Not at all __
3. Slightly __
4. Moderately __
5. Deeply __

? 1. Yes __ 2. No __
or a

(

Age __

s
Age stopped __
Check if still smoking cigars __
Does not apply __

ou Cigars per week __
d Does not apply __

eek
Cigars per week __
Check if not smoking cigars currently __

1. Never smoked __
2. Not at all __
3. Slightly __
4. Moderately __
5. Deeply __

Date _____

Part 2
PERIODIC MEDICAL QUESTIONNAIRE

1. NAME _____

2. SOCIAL SECURITY # ___ ___ ___ ___ ___ ___ ___ ___ ___ ___
1 2 3 4 5 6 7 8 9

3. CLOCK NUMBER ___ ___ ___ ___ ___ ___
10 11 12 13 14 15

4. PRESENT OCCUPATION _____

5. PLANT _____

6. ADDRESS _____

7. _____
(Zip Code)

8. TELEPHONE NUMBER _____

9. INTERVIEWER _____

10. DATE _____ ___ ___ ___ ___ ___ ___
16 17 18 19 20 21

11. What is your marital status? 1. Single __ 4. Separated/Divorced __
2. Married __
3. Widowed __

12. OCCUPATIONAL HISTORY

12A. In the past year, did you work full time (30 hours per week or more) for 6 months or more? 1. Yes __ 2. No __

IF YES TO 12A:

12B. In the past year, did you work in a dusty job? 1. Yes __ 2. No __ 3. Does Not Apply __

12C. Was dust exposure: 1. Mild __ 2. Moderate __ 3. Severe __

12D. In the past year, were you exposed to gas or chemical fumes in your work? 1. Yes __ 2. No __

12E. Was exposure: 1. Mild __ 2. Moderate __ 3. Severe __

12F. In the past year, what was your: 1. Job/occupation? _____
2. Position/job title? _____

13. RECENT MEDICAL HISTORY

13A. Do you consider yourself to be in good health? Yes ___ No ___

If NO, state reason _____

13B. In the past year, have you developed:

	Yes	No
Epilepsy?	___	___
Rheumatic fever?	___	___
Kidney disease?	___	___
Bladder disease?	___	___
Diabetes?	___	___
Jaundice?	___	___
Cancer?	___	___

14. CHEST COLDS AND CHEST ILLNESSES

14A. If you get a cold, does it usually go to your chest? (Usually means more than 1/2 the time)

1. Yes ___ 2. No ___
3. Don't get colds ___

15A. During the past year, have you had any chest illnesses that have kept you off work, indoors at home, or in bed?

1. Yes ___ 2. No ___
3. Does Not Apply ___

IF YES TO 15A:

15B. Did you produce phlegm with any of these chest illnesses?

1. Yes ___ 2. No ___
3. Does Not Apply ___

15C. In the past year, how many such illnesses with (increased) phlegm did you have which lasted a week or more?

Number of illnesses ___
No such illnesses ___

16. RESPIRATORY SYSTEM

In the past year have you had:

	Yes or No	Further Comment on Positive Answers
Asthma	_____	
Bronchitis	_____	
Hay Fever	_____	
Other Allergies	_____	

Pneumonia

Tuberculosis

Chest Surgery

Other Lung Problems

Heart Disease

Do you have:

Frequent colds

Chronic cough

Shortness of breath when walking or climbing one flight or stairs

Do you:

Wheeze

Cough up phlegm

Smoke cigarettes

Date _____

Yes ___ No ___

	Yes	No
epsy?	___	___
matic fever?	___	___
ey disease?	___	___
der disease?	___	___
etes?	___	___
dice?	___	___
er?	___	___

z go to your chest?
time)
1. Yes ___ 2. No ___
3. Don't get colds ___

d
e you
bed?
1. Yes ___ 2. No ___
3. Does Not Apply ___

1. Yes ___ 2. No ___
3. Does Not Apply ___

Number of illnesses ___
No such illnesses ___

Further Comment on Positive Answers

	Yes or No	Further Comment on Positive Answers
Pneumonia	____	
Tuberculosis	____	
Chest Surgery	____	
Other Lung Problems	____	
Heart Disease	____	

Do you have:

	Yes or No	Further Comment on Positive Answers
Frequent colds	____	
Chronic cough	____	
Shortness of breath when walking or climbing one flight or stairs	____	
Do you:		
Wheeze	____	
Cough up phlegm	____	
Smoke cigarettes	____	Packs per day ___ How many years ___

Date _____ Signature _____

APPENDIX E TO § 1910.1001—INTERPRETATION AND CLASSIFICATION OF CHEST ROENTGENOGRAMS—MANDATORY

(a) Chest roentgenograms shall be interpreted and classified in accordance with a professionally accepted Classification system and recorded on an interpretation form following the format of the CDC/NIOSH (M) 2.8 form. As a minimum, the content within the bold lines of this form (items 1 though 4) shall be included. This form is not to be submitted to NIOSH.

(b) Roentgenograms shall be interpreted and classified only by a B-reader, a board eligible/certified radiologist, or an experienced physician with known expertise in pneumoconioses.

(c) All interpreters, whenever interpreting chest roentgenograms made under this section, shall have immediately available for reference a complete set of the ILO-U/C International Classification of Radiographs for Pneumoconioses, 1980.

APPENDIX F TO § 1910.1001—WORK PRACTICES AND ENGINEERING CONTROLS FOR AUTOMOTIVE BRAKE REPAIR OPERATIONS—NON-MANDATORY

This appendix is intended as guidance for employers in the automotive brake and clutch repair industry who wish to reduce their employees' asbestos exposures during repair operations to levels below the new standard's action level (0.1 f/cc). OSHA believes that employers in this industry sector are likely to be able to reduce their employees' exposures to asbestos by employing the engineering and work practice controls described in Sections A and B of this appendix. Those employers who choose to use these controls and who achieve exposures below the action level will thus be able to avoid any burden that might be imposed by complying with such requirements as medical surveillance, recordkeeping, training, respiratory protection, and regulated areas, which are triggered when employee exposures exceed the action level or PEL.

Asbestos exposure in the automotive brake and clutch repair industry occurs primarily during the replacement of clutch plates and brake pads, shoes, and linings. Asbestos fibers may become airborne when an automotive mechanic removes the asbestos-containing residue that has been deposited as brakes and clutches wear. Employee exposures to asbestos occur during the cleaning of the brake drum or clutch housing.

Based on evidence in the rulemaking record (Exs. 84-74, 84-263, 90-148), OSHA believes that employers engaged in brake repair operations who implement any of the work practices and engineering controls described in Sections A and B of this appendix may be able to reduce their employees' exposures to levels below the action level (0.1 fiber/cc). These control methods and the relevant record evidence on these and other methods are described in the following sections.

A. Enclosed Cylinder/HEPA Vacuum System Method

The enclosed cylinder-vacuum system used in one of the facilities visited by representatives of the National Institute for Occupational Safety and Health (NIOSH) during a health hazard evaluation of brake repair facilities (Ex. 84-263) consists of three components:

(1) A wheel-shaped cylinder designed to cover and enclose the wheel assembly;

(2) A compressed-air hose and nozzle that fits into a port in the cylinder; and

(3) A HEPA-filtered vacuum used to evacuate airborne dust generated within the cylinder by the compressed air.

To operate the system, the brake assembly is enclosed in a cylinder that has viewing ports to provide visibility and cotton sleeves through which the mechanic can handle the brake assembly parts. The cylinder effectively isolates asbestos dust in the drum from the mechanic's breathing zone. One company manufactures the brake assembly isolation cylinder in two sizes to fit brake drums in the 7-to-12-inch size range common to automobiles and light trucks and the 12-to-19-inch size range common to large commercial vehicles. The cylinder is equipped with built-in compressed-air guns and a connection for a vacuum cleaner equipped with a High Efficiency Particulate Air (HEPA) filter. This type of filter is capable of removing all particles greater than 0.3 microns from the air. When the vacuum cleaner's filter is full, it must be replaced according to the manufacturer's instruction, and appropriate HEPA-filtered dual cartridge respirators should be worn during the process. The filter of the vacuum cleaner is assumed to be contaminated with asbestos fibers and should be handled carefully, wetted with a fine mist of water, placed immediately in a labelled plastic bag, and disposed of properly. When the cylinder is in place around the brake assembly and the HEPA vacuum is connected, compressed air is blown into the cylinder to loosen the residue from the brake assembly parts. The vacuum then evacuates the loosened material from within the cylinder, capturing the airborne material on the HEPA filter.

The HEPA vacuum system can be disconnected from the brake assembly isolation cylinder when the cylinder is not being used. The HEPA vacuum can then be used for clutch facing work, grinding, or other routine cleaning.

B. Compressed Air/Solvent Syste

A compressed-air hose fitted
with a bottle of solvent can
loosen the asbestos-containing
to capture the resulting airborn
in the solvent mist. The mecha
begin spraying the asbestos-cor
parts with the solvent at a suf
tance to ensure that the asbesto
are not dislodged by the velocity
rent spray. After the asbestos p
thoroughly wetted, the spray
brought closer to the parts and
may be sprayed as necessary
grease and other material. The
parts sprayed with the mist are
with a rag, which must then be
appropriately. Rags should be pl
belled plastic bag or other cont
they are still wet. This ensures
bestos fibers will not become air
the brake and clutch parts
cleaned. (If cleanup rags are
rather than disposed of, the
washed using methods appropr
laundering of asbestos-contamin
als.)

OSHA believes that a variant
pressed-air/solvent mist proces
vantages over the compressed
mist technique discussed abo
terms of costs and employee pro
variant involves the use of spra
with any of several solvent cl
mercially available from auto s
Spray cans of solvent are inexp
ily available, and easy to use.
will also save time, because no
ery system has to be asembled.
pressed-air hose/mister ensemb
lieves that a spray can will deli
the parts to be cleaned with
less force than the alternative
air delivery system described at
thus generate fewer airborne a
than the compressed-air m
Agency therefore believes that
levels of automotive repair me
the spray can/solvent mist pr
even lower than the exposure
NIOSH (Ex. 84-263) for the co
solvent mist system (0.08 f/cc).

*C. Information on the Effec
Various Control Meas*

The amount of airborne asb
ed during brake and clutch
ations depends on the work
engineering controls used dur
or removal activity. Data in t
record document the 8-hour
average (TWA) asbestos expo
sociated with various method
clutch repair and removal.

NIOSH submitted a report
entitled "Health Hazard E

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res to levels below the action level (0.1 /cc). These control methods and the ant record evidence on these and other nods are described in the following sec-s.

nclosed Cylinder/HEPA Vacuum System Method

ie enclosed cylinder-vacuum system in one of the facilities visited by repre-atives of the National Institute for Oc-ational Safety and Health (NIOSH) ng a health hazard evaluation of brake ir facilities (Ex. 84-263) consists of e components:

) A wheel-shaped cylinder designed to r and enclose the wheel assembly;

) A compressed-air hose and nozzle that into a port in the cylinder; and

) A HEPA-filtered vacuum used to evac-e airborne dust generated within the cyl-er by the compressed air.

o operate the system, the brake assem-is enclosed in a cylinder that has view-ports to provide visibility and cotton ves through which the mechanic can idle the brake assembly parts. The cylin-ely isolates asbestos dust in the the mechanic's breathing zone. e company manufactures the brake as-bly isolation cylinder in two sizes to fit ke drums in the 7-to-12-inch size range mon to automobiles and light trucks d the 12-to-19-inch size range common to ge commercial vehicles. The cylinder is ipped with built-in compressed-air guns d a connection for a vacuum cleaner ipped with a High Efficiency Particulate (HEPA) filter. This type of filter is ca-ble of removing all particles greater than microns from the air. When the vacuum aner's filter is full, it must be replaced ac-rding to the manufacturer's instruction. d appropriate HEPA-filtered dual car-dge respirators should be worn during the ocess. The filter of the vacuum cleaner is sumed to be contaminated with asbestos bers and should be handled carefully, etted with a fine mist of water, placed im-ediately in a labelled plastic bag, and dis-sed of properly. When the cylinder is in ace around the brake assembly and the EPA vacuum is connected, compressed air blown into the cylinder to loosen the resi-ie from the brake assembly parts. The cuum then evacuates the loosened materi-from within the cylinder, capturing the rborne material on the HEPA filter.

The HEPA vacuum system can be discon-ected from the brake assembly isolation linder when the cylinder is not being sed. The HEPA vacuum can then be used r clutch facing work, grinding, or other outine cleaning.

3. Compressed Air/Solvent System Method

A compressed-air hose fitted at the end with a bottle of solvent can be used to loosen the asbestos-containing residue and to capture the resulting airborne particles in the solvent mist. The mechanic should begin spraying the asbestos-contaminated parts with the solvent at a sufficient distance to ensure that the asbestos particles are not dislodged by the velocity of the solvent spray. After the asbestos particles are thoroughly wetted, the spray may be brought closer to the parts and the parts may be sprayed as necessary to remove grease and other material. The automotive parts sprayed with the mist are then wiped with a rag, which must then be disposed of appropriately. Rags should be placed in a labelled plastic bag or other container while they are still wet. This ensures that the asbestos fibers will not become airborne after the brake and clutch parts have been cleaned. (If cleanup rags are laundered rather than disposed of, they must be washed using methods appropriate for the laundering of asbestos-contaminated materials.)

OSHA believes that a variant of this compressed-air/solvent mist process offers advantages over the compressed-air/solvent mist technique discussed above, both in terms of costs and employee protection. The variant involves the use of spray cans filled with any of several solvent cleaners commercially available from auto supply stores. Spray cans of solvent are inexpensive, readily available, and easy to use. These cans will also save time, because no solvent delivery system has to be asembled, i.e., no compressed-air hose/mister ensemble. OSHA believes that a spray can will deliver solvent to the parts to be cleaned with considerably less force than the alternative compressed-air delivery system described above, and will thus generate fewer airborne asbestos fibers than the compressed-air method. The Agency therefore believes that the exposure levels of automotive repair mechanics using the spray can/solvent mist process will be even lower than the exposures reported by NIOSH (Ex. 84-263) for the compressed-air/solvent mist system (0.08 f/cc).

C. Information on the Effectiveness of Various Control Measures

The amount of airborne asbestos generated during brake and clutch repair operations depends on the work practices and engineering controls used during the repair or removal activity. Data in the rulemaking record document the 8-hour time-weighted average (TWA_8) asbestos exposure levels associated with various methods of brake and clutch repair and removal.

NIOSH submitted a report to the record entitled "Health Hazard Evaluation for Automotive Brake Repair" (Ex. 84-263). In addition, Exhibits 84-74 and 90-148 provided exposure data for comparing the airborne concentrations of asbestos generated by the use of various work practices during brake repair operations. These reports present exposure data for brake repair operations involving a variety of controls and work practices, including:

- Use of compressed air to blow out the brake drums;
- Use of a brush, without a wetting agent, to remove the asbestos-containing residue;
- Use of a brush dipped in water or a solvent to remove the asbestos-containing residue;
- Use of an enclosed vacuum cleaning system to capture the asbestos-containing residue; and
- Use of a solvent mixture applied with compressed air to remove the residue.

Prohibited Methods

The use of compressed air to blow the asbestos-containing residue off the surface of the brake drum removes the residue effectively but simultaneously produces an airborne cloud of asbestos fibers. According to NIOSH (Ex. 84-263), the peak exposures of mechanics using this technique were as high as 15 fibers/cc, and 8-hour TWA exposures ranged from 0.03 to 0.19 f/cc.

Dr. William J. Nicholson of the Mount Sinai School of Medicine (Ex. 84-74) cited data from Knight and Hickish (1970) that indicated that the concentration of asbestos ranged from 0.84 to 5.35 f/cc over a 60-minute sampling period when compressed air was being used to blow out the asbestos-containing residue from the brake drum. In the same study, a peak concentration of 87 f/cc was measured for a few seconds during brake cleaning performed with compressed air. Rohl et al. (1976) (Ex. 90-148) measured area concentrations (of unspecified duration) within 3-5 feet of operations involving the cleaning of brakes with compressed air and obtained readings ranging from 6.6 to 29.8 f/cc. Because of the high exposure levels that result from cleaning brake and clutch parts using compressed air, OSHA has prohibited this practice in the revised standard.

Ineffective Methods

When dry brushing was used to remove the asbestos-containing residue from the brake drums and wheel assemblies, peak exposures measured by NIOSH ranged from 0.61 to 0.81 f/cc, while 8-hour TWA levels were at the new standard's permissible exposure limit (PEL) of 0.2 f/cc (Ex. 84-263). Rohl and his colleagues (Ex. 90-148) collected area samples 1-3 feet from a brake cleaning operation being performed with a dry

brush, and measured concentrations ranging from 1.3 to 3.6 f/cc; however, sampling times and TWA concentrations were not presented in the Rohl et al. study.

When a brush wetted with water, gasoline, or Stoddart solvent was used to clean the asbestos-containing residue from the affected parts, exposure levels (8-hour TWAs) measured by NIOSH also exceeded the new 0.2 f/cc PEL, and peak exposures ranged as high as 2.62 f/cc (Ex. 84-263).

Preferred Methods

Use of an engineering control system involving a cylinder that completely encloses the brake shoe assembly and a High Efficiency Particulate Air (HEPA) filter-equipped vacuum produced 8-hour TWA employee exposures of 0.01 f/cc and peak exposures ranging from nondetectable to 0.07 f/cc (Ex. 84-263). (Because this system achieved exposure levels below the standard's action level, it is described in detail above.) Data collected by the Mount Sinai Medical Center (Ex. 90-148) for Nilfisk of America, Inc., the manufacturer of the brake assembly enclosure system, showed that for two of three operations sampled, the exposure of mechanics to airborne asbestos fibers was nondetectable. For the third operator sampled by Mt. Sinai researchers, the exposure was 0.5 f/cc, which the authors attributed to asbestos that had contaminated the operator's clothing in the course of previous brake repair operations performed without the enclosed cylinder/vacuum system.

Some automotive repair facilities use a compressed-air hose to apply a solvent mist to remove the asbestos-containing residue from the brake drums before repair. The NIOSH data (Ex. 84-263) indicated that mechanics employing this method experienced exposures (8-hour TWAs) of 0.8 f/cc, with peaks of 0.25 to 0.68 f/cc. This technique, and a variant of it that OSHA believes is both less costly and more effective in reducing employee exposures, is described in greater detail above in Sections A and B.

D. Summary

In conclusion, OSHA believes that it is likely that employers in the brake and clutch repair industry will be able to avail themselves of the action level trigger built into the revised standard if they conscientiously employ one of the three control methods described above: the enclosed cylinder/HEPA vacuum system, the compressed air/solvent method, or the spray can/solvent mist system.

APPENDIX G TO § 1910.1001—SUBSTANCE TECHNICAL INFORMATION FOR ASBESTOS—NON-MANDATORY

I. Substance Identification

A. Substance: "Asbestos" is the name of a class of magnesium-silicate minerals that occur in fibrous form. Minerals that are included in this group are chrysotile, crocidolite, amosite, tremolite asbestos, anthophyllite asbestos, and actinolite asbestos.

B. Asbestos, tremolite, anthophyllite, and actinolite are used in the manufacture of heat-resistant clothing, automative brake and clutch linings, and a variety of building materials including floor tiles, roofing felts, ceiling tiles, asbestos-cement pipe and sheet, and fire-resistant drywall. Asbestos is also present in pipe and boiler insulation materials, and in sprayed-on materials located on beams, in crawlspaces, and between walls.

C. The potential for a product containing asbestos, tremolite, anthophyllite, and actinolite to release breatheable fibers depends on its degree of friability. Friable means that the material can be crumbled with hand pressure and is therefore likely to emit fibers. The fibrous or fluffy sprayed-on materials used for fireproofing, insulation, or sound proofing are considered to be friable, and they readily release airborne fibers if disturbed. Materials such as vinyl-asbestos floor tile or roofing felts are considered nonfriable and generally do not emit airborne fibers unless subjected to sanding or sawing operations. Asbestos-cement pipe or sheet can emit airborne fibers if the materials are cut or sawed, or if they are broken during demolition operations.

D. Permissible exposure: Exposure to airborne asbestos, tremolite, anthophyllite, and actinolite fibers may not exceed 0.2 fibers per cubic centimeter of air (0.2 f/cc) averaged over the 8-hour workday.

II. Health Hazard Data

A. Asbestos, tremolite, anthophyllite, and actinolite can cause disabling respiratory disease and various types of cancers if the fibers are inhaled. Inhaling or ingesting fibers from contaminated clothing or skin can also result in these diseases. The symptoms of these diseases generally do not appear for 20 or more years after initial exposure.

B. Exposure to asbestos, tremolite, anthophyllite, and actinolite has been shown to cause lung cancer, mesothelioma, and cancer of the stomach and colon. Mesothelioma is a rare cancer of the thin membrane lining of the chest and abdomen. Symptoms of mesothelioma include shortness of breath, pain in the walls of the chest, and/or abdominal pain.

III. Respirators and Protective C

A. Respirators: You are required
respirator when performing
result in asbestos, tremolite, anth
and actinolite exposure that ex
permissible exposure limit (PEL)
These conditions can occur while
ployer is in the process of insta
neering controls to reduce asbest
lite, anthophyllite, and actinolite
or where engineering controls are
ble to reduce asbestos, tremolite,
lite, and actinolite exposure. A
respirators equipped with a high
particulate air (HEPA) filter ca
where airborne asbestos, tremol
phyllite, and actinolite fiber con
do not exceed 2 f/cc; otherwise, a
positive-pressure, full facepiece
must be used. Disposable respira
masks are not permitted to be
bestos, tremolite, anthophyllite,
lite work. For effective protecti
tors must fit your face and he
Your employer is required to
tests when you are first assigne
tor and every 6 months thereaft
tors should not be loosened or
work situations where their use

B. Protective Clothing: You a
to wear protective clothing in
where asbestos, tremolite, an
and actinolite fiber concentrat
the permissible exposure limit
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Where protective clothing is re
employer must provide you wit
ments. Unless you are working o
bestos, tremolite, anthophyllite,
lite removal or demolition proje
ployer must also provide a chan
separate lockers for your street
contaminated work clothes. If y
ing on a large asbestos, trem
phyllite, and actinolite remova
tion project, and where it is fe
so, your employer must prov
room, shower, and decontami
contiguous to the work area. W
the work area, you must rem
nated clothing before proce
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work area, you must vacuum y
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shower. To prevent inhaling f
taminated change rooms and s
your respirator on until yo
shower and enter the clean cha

IV. Disposal Procedures an

A. Wastes that are generated
where asbestos, tremolite, a
and actinolite are present inclu

1. Empty asbestos, tremolit
lite, and actinolite shipping co

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C. The potential for a product containing asbestos, tremolite, anthophyllite, and actinolite to release breatheable fibers depends on its degree of friability. Friable means that the material can be crumbled with hand pressure and is therefore likely to emit fibers. The fibrous or fluffy sprayed-on materials used for fireproofing, insulation, sound proofing are considered to be friable and they readily release airborne fibers if disturbed. Materials such as vinyl-asbestos floor tile or roofing felts are considered nonfriable and generally do not emit airborne fibers unless subjected to sanding or sawing operations. Asbestos-cement pipe or sheet can emit airborne fibers if the materials are cut or sawed, or if they are broken during demolition operations.

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B. Exposure to asbestos, tremolite, anthophyllite, and actinolite has been shown to cause lung cancer, mesothelioma, and cancer of the stomach and colon. Mesothelioma is a rare cancer of the thin membrane lining of the chest and abdomen. Symptoms of mesothelioma include shortness of breath, pain in the walls of the chest, and/or abdominal pain.

III. Respirators and Protective Clothing

A. Respirators: You are required to wear a respirator when performing tasks that result in asbestos, tremolite, anthophyllite, and actinolite exposure that exceeds the permissible exposure limit (PEL) of 0.2 f/cc. These conditions can occur while your employer is in the process of installing engineering controls to reduce asbestos, tremolite, anthophyllite, and actinolite exposure, or where engineering controls are not feasible to reduce asbestos, tremolite, anthophyllite, and actinolite exposure. Air-purifying respirators equipped with a high-efficiency particulate air (HEPA) filter can be used where airborne asbestos, tremolite, anthophyllite, and actinolite fiber concentrations do not exceed 2 f/cc: otherwise, air-supplied, positive-pressure, full facepiece respirators must be used. Disposable respirators or dust masks are not permitted to be used for asbestos, tremolite, anthophyllite, and actinolite work. For effective protection, respirators must fit your face and head snugly. Your employer is required to conduct fit tests when you are first assigned a respirator and every 6 months thereafter. Respirators should not be loosened or removed in work situations where their use is required.

B. Protective Clothing: You are required to wear protective clothing in work areas where asbestos, tremolite, anthophyllite, and actinolite fiber concentrations exceed the permissible exposure limit (PEL) of 0.2 f/cc to prevent contamination of the skin. Where protective clothing is required, your employer must provide you with clean garments. Unless you are working on a large asbestos, tremolite, anthophyllite, and actinolite removal or demolition project, your employer must also provide a change room and separate lockers for your street clothes and contaminated work clothes. If you are working on a large asbestos, tremolite, anthophyllite, and actinolite removal or demolition project, and where it is feasible to do so, your employer must provide a clean room, shower, and decontamination room contiguous to the work area. When leaving the work area, you must remove contaminated clothing before proceeding to the shower. If the shower is not adjacent to the work area, you must vacuum your clothing before proceeding to the change room and shower. To prevent inhaling fibers in contaminated change rooms and showers, leave your respirator on until you leave the shower and enter the clean change room.

IV. Disposal Procedures and Cleanup

A. Wastes that are generated by processes where asbestos, tremolite, anthophyllite, and actinolite are present include:

1. Empty asbestos, tremolite, anthophyllite, and actinolite shipping containers.

2. Process wastes such as cuttings, trimmings, or reject material.

3. Housekeeping waste from sweeping or vacuuming.

4. Asbestos, tremolite, anthophyllite, and actinolite fireproofing or insulating material that is removed from buildings.

5. Building products that contain asbestos, tremolite, anthophyllite, and actinolite removed during building renovation or demolition.

6. Contaminated disposable protective clothing.

B. Empty shipping bags can be flattened under exhaust hoods and packed into air-tight containers for disposal. Empty shipping drums are difficult to clean and should be sealed.

C. Vacuum bags or disposable paper filters should not be cleaned, but should be sprayed with a fine water mist and placed into a labeled waste container.

D. Process waste and housekeeping waste should be wetted with water or a mixture of water and surfactant prior to packaging in disposable containers.

E. Material containing asbestos, tremolite, anthophyllite, and actinolite that is removed from buildings must be disposed of in leak-tight 6-mil thick plastic bags, plastic-lined cardboard containers, or plastic-lined metal containers. These wastes, which are removed while wet, should be sealed in containers before they dry out to minimize the release of asbestos, tremolite, anthophyllite, and actinolite fibers during handling.

V. Access to Information

A. Each year, your employer is required to inform you of the information contained in this standard and appendices for asbestos, tremolite, anthophyllite, and actinolite. In addition, your employer must instruct you in the proper work practices for handling materials containing asbestos, tremolite, anthophyllite, and actinolite, and the correct use of protective equipment.

B. Your employer is required to determine whether you are being exposed to asbestos, tremolite, anthophyllite, and actinolite. You or your representative has the right to observe employee measurements and to record the results obtained. Your employer is required to inform you of your exposure, and, if you are exposed above the permissible limit, he or she is required to inform you of the actions that are being taken to reduce your exposure to within the permissible limit.

C. Your employer is required to keep records of your exposures and medical examinations. These exposure records must be kept for at least thirty (30) years. Medical records must be kept for the period of your employment plus thirty (30) years.

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D. Your employer is required to release your exposure and medical records to your physician or designated representative upon your written request.

APPENDIX H TO § 1910.1001—MEDICAL SURVEILLANCE GUIDELINES FOR ASBESTOS TREMOLITE, ANTHOPHYLLITE, AND ACTINOLITE NON-MANDATORY

I. Route of Entry Inhalation, Ingestion

II. Toxicology

Clinical evidence of the adverse effects associated with exposure to asbestos, tremolite, anthophyllite, and actinolite, is present in the form of several well-conducted epidemiological studies of occupationally exposed workers, family contacts of workers, and persons living near asbestos, tremolite, anthophyllite, and actinolite mines. These studies have shown a definite association between exposure to asbestos, tremolite, anthophyllite, and actinolite and an increased incidence of lung cancer, pleural and peritoneal mesothelioma, gastrointestinal cancer, and asbestosis. The latter is a disabling fibrotic lung disease that is caused only by exposure to asbestos. Exposure to asbestos, tremolite, anthophyllite, and actinolite has also been associated with an increased incidence of esophageal, kidney, laryngeal, pharyngeal, and buccal cavity cancers. As with other known chronic occupational diseases, disease associated with asbestos, tremolite, anthophyllite, and actinolite generally appears about 20 years following the first occurrence of exposure: There are no known acute effects associated with exposure to asbestos, tremolite, anthophyllite, and actinolite.

Epidemiological studies indicate that the risk of lung cancer among exposed workers who smoke cigarettes is greatly increased over the risk of lung cancer among non-exposed smokers or exposed nonsmokers. These studies suggest that cessation of smoking will reduce the risk of lung cancer for a person exposed to asbestos, tremolite, anthophyllite, and actinolite but will not reduce it to the same level of risk as that existing for an exposed worker who has never smoked.

III. Signs and Symptoms of Exposure-Related Disease

The signs and symptoms of lung cancer or gastrointestinal cancer induced by exposure to asbestos, tremolite, anthophyllite, and actinolite are not unique, except that a chest X-ray of an exposed patient with lung cancer may show pleural plaques, pleural calcification, or pleural fibrosis. Symptoms characteristic of mesothelioma include shortness of breath, pain in the walls of the chest, or abdominal pain. Mesothelioma has a much longer latency period compared with lung cancer (40 years versus 15-20 years), and mesothelioma is therefore more likely to be found among workers who were first exposed to asbestos at an early age. Mesothelioma is always fatal.

Asbestosis is pulmonary fibrosis caused by the accumulation of asbestos fibers in the lungs. Symptoms include shortness of breath, coughing, fatigue, and vague feelings of sickness. When the fibrosis worsens, shortness of breath occurs even at rest. The diagnosis of asbestosis is based on a history of exposure to asbestos, the presence of characteristic radiologic changes, end-inspiratory crackles (rales), and other clinical features of fibrosing lung disease. Pleural plaques and thickening are observed on X-rays taken during the early stages of the disease. Asbestosis is often a progressive disease even in the absence of continued exposure, although this appears to be a highly individualized characteristic. In severe cases, death may be caused by respiratory or cardiac failure.

IV. Surveillance and Preventive Considerations

As noted above, exposure to asbestos, tremolite, anthophyllite, and actinolite has been linked to an increased risk of lung cancer, mesothelioma, gastrointestinal cancer, and asbestosis among occupationally exposed workers. Adequate screening tests to determine an employee's potential for developing serious chronic diseases, such as cancer, from exposure to asbestos, tremolite, anthophyllite, and actinolite do not presently exist. However, some tests, particularly chest X-rays and pulmonary function tests, may indicate that an employee has been overexposed to asbestos, tremolite, anthophyllite, and actinolite, increasing his or her risk of developing exposure-related chronic diseases. It is important for the physician to become familiar with the operating conditions in which occupational exposure to asbestos, tremolite, anthophyllite, and actinolite is likely to occur. This is particularly important in evaluating medical and work histories and in conducting physical examinations. When an active employee has been identified as having been overexposed to asbestos, tremolite, anthophyllite, and actinolite, measures taken by the employer to eliminate or mitigate further exposure should also lower the risk of serious long-term consequences.

The employer is required to institute a medical surveillance program for all employees who are or will be exposed to asbestos, tremolite, anthophyllite, actinolite or a combination of these minerals at or above the action level (0.1 fiber per cubic centimeter of air). All examinations and procedures must be performed by or under the supervision of a licensed physician, at a reasonable

time and place, and at no
ployee.

Although broad latitude
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lowing elements in the routi

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(ii) Completion of the res
questionnaire contained in A

(iii) A physical examinat
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The employer is required to institute a medical surveillance program for all employees who are or will be exposed to asbestos, tremolite, anthophyllite, actinolite or a combination of these minerals at or above the action level (0.1 fiber per cubic centimeter of air). All examinations and procedures must be performed by or under the supervision of a licensed physician, at a reasonable

time and place, and at no cost to the employee.

Although broad latitude is given to the physician in prescribing specific tests to be included in the medical surveillance program, OSHA requires inclusion of the following elements in the routine examination:

(i) Medical and work histories with special emphasis directed to symptoms of the respiratory system, cardiovascular system, and digestive tract.

(ii) Completion of the respiratory disease questionnaire contained in Appendix D.

(iii) A physical examination including a chest roentgenogram and pulmonary function test that includes measurement of the employee's forced vital capacity (FVC) and forced expiratory volume at one second (FEV$_1$).

(iv) Any laboratory or other test that the examining physician deems by sound medical practice to be necessary.

The employer is required to make the prescribed tests available at least annually to those employees covered; more often than specified if recommended by the examining physician; and upon termination of employment.

The employer is required to provide the physician with the following information: A copy of this standard and appendices; a description of the employee's duties as they relate to asbestos exposure; the employee's representative level of exposure to asbestos, tremolite, anthophyllite, and actinolite; a description of any personal protective and respiratory equipment used; and information from previous medical examinations of the affected employee that is not otherwise available to the physician. Making this information available to the physician will aid in the evaluation of the employee's health in relation to assigned duties and fitness to wear personal protective equipment, if required.

The employer is required to obtain a written opinion from the examining physician containing the results of the medical examination; the physician's opinion as to whether the employee has any detected medical conditions that would place the employee at an increased risk of exposure-related disease; any recommended limitations on the employee or on the use of personal protective equipment; and a statement that the employee has been informed by the physician of the results of the medical examination and of any medical conditions related to asbestos, tremolite, anthophyllite, and actinolite exposure that require further explanation or treatment. This written opinion must not reveal specific findings or diagnoses unrelated to exposure to asbestos, tremolite, anthophyllite, and actinolite, and a copy of the opinion must be provided to the affected employee.

(The information collection requirements contained in paragraphs (d)(2), (d)(3), (d)(5), (d)(7), (f)(2), (g)(3)(i), (j)(5), (l) and (m) have been approved by the Office of Management and Budget under Control No. 1218-0133)

[51 FR 22733, June 20, 1986, as amended at 51 FR 37004, Oct. 17, 1986; 52 FR 17754, 17755, May 12, 1987]

NOTE: Pursuant to an administrative stay effective July 21, 1986, published on October 17, 1986, (51 FR 37002) and extended to July 21, 1988 (at 52 FR 15722, Apr. 30, 1987) enforcement of this section is stayed as it applies to non-asbestiform tremolite, anthophyllite and actinolite. During the period and to the extent of this stay, the 1972 standard governing occupational exposure to asbestos (redesignated as 29 CFR 1910.1101) will remain in effect.

§ 1910.1002 Coal tar pitch volatiles; interpretation of term.

As used in § 1910.1000 (Table Z-1), coal tar pitch volatiles include the fused polycyclic hydrocarbons which volatilize from the distillation residues of coal, petroleum (excluding asphalt), wood, and other organic matter. Asphalt (CAS 8052-42-4, and CAS 64742-93-4) is not covered under the "coal tar pitch volatiles" standard.

[48 FR 2768, Jan. 21, 1983]

§ 1910.1003 4-Nitrobiphenyl.

(a) *Scope and application.* (1) This section applies to any area in which 4-Nitrobiphenyl, Chemical Abstracts Service Registry Number 92933 is manufactured, processed, repackaged, released, handled, or stored, but shall not apply to trans-shipment in sealed containers, except for the labeling requirements under paragraphs (e) (2), (3), and (4) of this section.

(2) This section shall not apply to solid or liquid mixtures containing less than 0.1 percent by weight or volume of 4-Nitrobiphenyl.

(b) *Definitions.* For the purposes of this section: (1) "Absolute filter" is one capable of retaining 99.97 percent of a mono disperse aerosol of 0.3 μm particles.

(2) "Authorized employee" means an employee whose duties require him to be in the regulated area and who has been specifically assigned by the employer.