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OCCUPATIONAL SAFETY AND HEALTH STANDARDS
SUBPART G - OCCUPATIONAL HEALTH AND ENVIRONMENTAL CONTROL

(Code of Federal Regulations, Title 29, Chapter XVII, Part 1910, 37 FR 22139
October 18, 1972, with subsequent amendments indicated where appropriate in the text.)

Subpart G—Occupational Health and Environmental Control

§ 1910.93 Air contaminants.

An employee's exposure to any material listed in table G-1, G-2, or G-3 of this section shall be limited in accordance with the requirements of the following paragraphs of this section.

(a) Table G-1:

(1) *Materials with names preceded by "C"—Ceiling Values.* An employee's exposure to any material in table G-1, the name of which is preceded by a "C" (e.g., C Boron trifluoride), shall at no time exceed the ceiling value given for that material in the table.

(2) *Other materials—8-hour time weighted averages.* An employee's exposure to any material in table G-1, the name of which is not preceded by "C", in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average given for that material in the table.

(b) Table G-2:

(1) *8-hour time weighted averages.* An employee's exposure to any material listed in table G-2, in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average limit given for that material in the table.

(2) *Acceptable ceiling concentrations.* An employee's exposure to a material listed in table G-2 shall not exceed at any time during an 8-hour shift the acceptable ceiling concentration limit given for the material in the table, except for a time period, and up to a concentration not exceeding the maximum duration and concentration allowed in the column under "acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift".

(3) *Example.* During an 8-hour work shift, an employee may be exposed to a concentration of Benzene above 25 p.p.m. (but never above 50 p.p.m.) only for a maximum period of 10 minutes. Such exposure must be compensated by exposures to concentrations less than 10 p.p.m. so that the cumulative exposure

for the entire 8-hour work shift does not exceed a weighted average of 10 p.p.m.

(c) Table G-3: An employee's exposure to any material listed in table G-3, in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average limit given for that material in the table.

(d) Computation formulae:

(1) (i) The cumulative exposure for an 8-hour work shift shall be computed as follows:

$$E = C_1 T_1 + C_2 T_2 + \dots C_n T_n$$

where:

E is the equivalent exposure for the working shift.

C is the concentration during any period of time T where the concentration remains constant.

T is the duration in hours of the exposure at the concentration C.

The value of E shall not exceed the 8-hour time weighted average limit in table



G-1, G-2, or G-3 for the material involved.

(4) To illustrate the formula prescribed in subdivision (1) of this subparagraph, note that isoamyl acetate has an 8-hour time weighted average limit of 100 p.p.m. (table G-1). Assume that an employee is subject to the following exposure:

Two hours exposure at 150 p.p.m.
Four hours exposure at 75 p.p.m.
Four hours exposure at 50 p.p.m.

Substituting this information in the formula, we have

$$\frac{2 \times 150 + 4 \times 75 + 4 \times 50}{8} = 81.25 \text{ p.p.m.}$$

Since 81.25 p.p.m. is less than 100 p.p.m., the 8-hour time weighted average limit, the exposure is acceptable.

(2) (i) In case of a mixture of air contaminants an employer shall compute the equivalent exposure as follows:

$$E = \frac{C_1}{L_1} + \frac{C_2}{L_2} + \dots + \frac{C_n}{L_n}$$

Where:

E is the equivalent exposure for the mixture.

C is the concentration of a particular contaminant.

L is the exposure limit for that contaminant, from table G-1, G-2, or G-3.

The value of E shall not exceed unity (1).

(ii) To illustrate the formula prescribed in subdivision (1) of this subparagraph, consider the following exposures:

Material	Actual concentration of 8-hour exposure	8-hour time weighted average exposure limit
Axetone (Table G-1)	500 p.p.m.	1,000 p.p.m.
2-Butanone (Table G-1)	45 p.p.m.	200 p.p.m.
Toluene (Table G-2)	40 p.p.m.	250 p.p.m.

Substituting in the formula, we have:

$$E = \frac{500}{1,000} + \frac{45}{200} + \frac{40}{250}$$

$$E = 0.500 + 0.225 + 0.200$$

$$E = 0.925$$

Since E is less than unity (1), the exposure combination is within acceptable limits.

(e) To achieve compliance with paragraph (a) through (d) of this section, administrative or engineering controls must first be determined and implemented whenever feasible. When such controls are not feasible to achieve full compliance, protective equipment or any other protective measures shall be used to keep the exposure of employees to air contaminants within the limits prescribed in this section. Any equipment and/or technical measures used for this purpose must be approved for each particular use by a competent industrial hygienist or other technically qualified person. Whenever respirators are used, their use shall comply with § 1910.134.

TABLE G-1

Substance	P.P.M.*	mg./M ³ *
Acealdehyde	100/100	100
Acetic acid	10	10
Acetic anhydride	10	10
Acetone	1,000	2,000
Acetonitrile	10	10
Aerylene dichloride, see 1,2-Dichloroethylene		
Aerylene trichloride	1	1
Aerylene	1	1
Aerylene-8-hm	10	10
Aerylene-8-hm	10	10
Allyl alcohol-8-hm	1	1
Allyl chloride	1	1
*C Allyl glycidyl ether (AGE)	10	10
Allyl propyl dimethyl	1	1
3-Aminobenzene, see Ethanolamine		
2-Aminopyridine	1	1
*Ampyrene	10/25	10
Ammenium sulfide (A.S.)	10	10
n-Amyl acetate	100	100
n-Amyl acetate	100	100
Aniline-8-hm	10	10
Aniline (o, p-isomers)-8-hm	10	10
Antimony and compounds (see Sb)		
ANTU (alpha naphthyl thiourea)	1	1
Arsenic and compounds (see As)		
Arsine	0.1	0.1
Asiophen-methyl-8-hm	10	10
Barium (soluble compounds)	1	1
p-Benzquinone, see Quinone		
Benzaldehyde	1	1
Benzyl chloride	1	1
Biphenyl, see Diphenyl		
Bisphenol A, see Diglycidyl ether		
Born oxide	1	1
C Boron trifluoride	1	1
Bromine	0.1	0.1
Bromine-8-hm	10	10
Butadiene (1,3-butadiene)	1,000	2,000
Butanediol, see Butyl mercaptan		
2-Butanone	200	200
2-Butoxy ethanol (Butyl Cellosolve)-8-hm	10	10
Butyl acetate (n-butyl acetate)	100	100
Butyl acetate	200	200
tert-Butyl acetate	200	200
Butyl alcohol	100	100
sec-Butyl alcohol	100	100
tert-Butyl alcohol	100	100
C Butylamine-8-hm	1	1
C Butylamine	1	1
C Butyl ethoxide	1	1
Butyl glycidyl ether (BGE)	10	10
*Butyl mercaptan	10	10
p-tert-Butylphenol	10	10
Calcium arsenate	1	1
Calcium oxide	1	1
*Camphor	1	1
Carbon black	1	1
Carbon dioxide	1,000 / 5 sec 1,000	1,000
Carbon monoxide	10	10
Chloroform-8-hm	10	10
Chlorinated camphor-8-hm	10	10
Chlorinated diphenyl oxide	1	1
*Chlorine	1	1
Chlorine dioxide	0.1	0.1
C Chlorine trifluoride	0.1	0.1
C Chloroacetaldehyde	1	1
*Chloroacetonitrile (phenylacetonitrile)	0.1	0.1
Chlorobenzene (monochlorobenzene)	75	200
*Chlorobenzylidene malonitrile (CCBM)	0.1	0.1
Chlorobromomethane	100	1,000
2-Chloro-1,3-butadiene, see Chlorobutene		
Chlorobutene	1	1
Chlorodiphenyl (45 percent Chlorine)-8-hm	1	1
Chlorodiphenyl (34 percent Chlorine)-8-hm	1	1
1-Chloro-2,3-dimethylpropane, see Epichlorohydrin		
2-Chloroethanol, see Ethylene chlorohydrate		
Chloroethylene, see Vinyl chloride		
C Chloroform (trichloromethane)	10/25	100/250
1-Chloro-1-nitrobenzene	10	10
Chloroform	0.1	0.1
Chloroform (2-chloro-1,3-butadiene)-8-hm	10	10

Bismuth telluride - 10
" " (Se dopant) - 5

Butane - 500
Caplaning Oxide fumes - 0.05

Is Chloroethyl ether - 5
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TABLE G-1—Continued

Substance	P.P.M.*	mg./M ³ *
Chromic acid (CrO ₃)	0.05	0.05
Chromic anhydride	0.05	0.05
Chromic salts of Cr	0.1	0.1
Coal tar pitch volatiles (non-soluble fraction) anthracene, BaP, phenanthrene, benzo(a)pyrene, chrysene, pyrene	0.2	0.2
Cobalt, metal fume and dust	0.1	0.1
Copper fume	0.1	0.1
Cotton dust (raw)	1	1
Cotton dust (spun)	1	1
Crotonaldehyde-8-hm	1	1
Crotonaldehyde	1	1
Cumene-8-hm	10	10
Cyanide (as CN)-8-hm	1	1
Cyclohexane	1,000	1,000
Cyclohexanol	100	100
Cyclohexanone	100	100
Cyclohexanone	100	100
Cyclohexanone	100	100
2,4-D	10	10
DDT-8-hm	1	1
DDVP, see Dichlorvos		
Dechlorane-8-hm	0.05	0.05
Dechlorane-8-hm	0.1	0.1
Dibenzene alcohol (6-hydroxy-2-methyl-2-pentanol)	10	100
1,2-Dichloroethane, see Ethylenedichloride		
Dichloromethane	0.1	0.1
Dibenzene	0.1	0.1
Dibutylphthalate	1	1
C-Dichlorobenzene	10	100
p-Dichlorobenzene	10	100
Dichlorodifluoromethane	1,000	1,000
1,2-Dichloro-4,4-dimethylhydantoin	0.1	0.1
1,2-Dichloroethane	100/200	100/200
1,2-Dichloroethane	100	100
C Dichloroethyl ether-8-hm	10/5	10/30
Dichloromethane, see Ethylenedichloride		
Dichloromethane	1,000	1,000
C 1,1-Dichloro-1-nitroethane	10	10
1,2-Dichloropropane, see Propylenedichloride		
Dichlorotetrafluoroethane	1,000	1,000
Dichlorvos (DDVP)-8-hm	1	1
Dieldrin-8-hm	0.1	0.1
Dibutylamine	10	10
Dibutylamine ethanol-8-hm	10	10
Dibutylamine	10	10
Dibutylamine, see Ethyl ether		
Dichlorodibromomethane	100	100
C Diglycidyl ether (DGE)	0.1	0.1
Dihydroxybenzene, see Hydroquinone		
Dibutyl ketone	10/25	100/250
Dimethoxybenzene-8-hm	10	10
Dimethoxybenzene, see Methyl cellosolve		
Dimethyl acetamide-8-hm	10	10
Dimethylamine	10	10
Dimethylmethoxybenzene, see Xylene		
Dimethylamine (N-dimethylamine)-8-hm	1	10
Dimethylamine, see Xylene		
Dimethyl 1,3-dibromo-2,3-dichloroethyl phosphite (Dibrom)	10	10
Dimethylhydrazine-8-hm	10	10
2,5-Dimethylterephthalene, see Diphenyl ketone		
1,4-Dimethylterephthalene-8-hm	0.1	0.1
Dimethylphthalate	1	1
Dimethylsiloxane-8-hm	1	1
Dinitrobenzene (all isomers)-8-hm	1	1
Dinitrobenzene-8-hm	0.1	0.1
Dinitrobenzene-8-hm	1	1
Dinitrobenzene (all isomers)-8-hm	100	100
Diphenyl	0.1	0.1
Diphenylmethane diisocyanate (see Methylene bisphenyl isocyanate (MDI))		
Dipropylene glycol methyl ether-8-hm	100	100
Di-sec-ethyl phthalate (DEP-ethylphthalate)	1	1
Ethylene-8-hm	0.1	0.1
Ethylbenzene-8-hm	10	10
EPN-8-hm	1	1
1,2-Epoxypropane, see Propylenedichloride		
2,2,2-Trifluoro-1-propanol, see Glycidol		

See footnotes at end of table.

1,2-Dibromomethane-8-hm 20 145
Piquat - 0.5

TABLE O-2

Material	8-hour time weighted average	Acceptable ceiling concentration	Acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift	
			Concentration	Maximum duration
Benzene (Z37.6-1969)	10 p.p.m.	25 p.p.m.	50 p.p.m.	10 minutes
Beryllium and beryllium compounds (Z37.29-1970)	2 µg/M ³	5 µg/M ³	25 µg/M ³	20 minutes
Cadmium fume (Z37.5-1970)	0.1 mg/M ³	0.5 mg/M ³		
Cadmium dust (Z37.5-1970)	0.5 mg/M ³	5 mg/M ³		
Carbon disulfide (Z37.3-1968)	20 p.p.m.	20 p.p.m.	100 p.p.m.	Do.
Carbon tetrachloride (Z37.17-1967)	10 p.p.m.	25 p.p.m.	200 p.p.m.	5 minutes in any 4 hours
Ethylene dibromide (Z37.31-1970)	20 p.p.m.	20 p.p.m.	50 p.p.m.	5 minutes in any 4 hours
Ethylene dichloride (Z37.31-1968)	50 p.p.m.	100 p.p.m.	200 p.p.m.	5 minutes in any 4 hours
Formaldehyde (Z37.16-1967)	3 p.p.m.	5 p.p.m.	10 p.p.m.	20 minutes
Hydrogen fluoride (Z37.25-1969)	0.5 mg/M ³	5 mg/M ³		
Fluoride as dust (Z37.25-1969)	2.5 mg/M ³	25 mg/M ³		
Lead and its inorganic compounds (Z37.11-1968)	0.05 mg/M ³	0.5 mg/M ³		
Methyl chloride (Z37.18-1968)	100 p.p.m.	200 p.p.m.	200 p.p.m.	5 minutes in any 4 hours
Methylene Chloride (Z37.3-1968)	200 p.p.m.	1,000 p.p.m.	2,000 p.p.m.	5 minutes in any 4 hours
Organic (alkyl) mercury (Z37.30-1968)	0.01 mg/M ³	0.01 mg/M ³		
Selenium (Z37.15-1968)	100 p.p.m.	200 p.p.m.	200 p.p.m.	5 minutes in any 4 hours
Trichloroethylene (Z37.19-1967)	100 p.p.m.	200 p.p.m.	200 p.p.m.	5 minutes in any 4 hours
Tetrachloroethylene (Z37.22-1967)	100 p.p.m.	200 p.p.m.	200 p.p.m.	5 minutes in any 4 hours
Toluene (Z37.12-1967)	100 p.p.m.	200 p.p.m.	200 p.p.m.	5 minutes in any 4 hours
Hydrogen sulfide (Z37.3-1968)	20 p.p.m.	50 p.p.m.	100 p.p.m.	10 minutes once only if no other combustible or poison gases
Mercury (Z37.9-1971)	0.05 mg/M ³	0.05 mg/M ³		
Chromic acid and chromates (Z37.7-1971)	0.05 mg/M ³	0.05 mg/M ³		

TABLE O-3—Mineral Dusts

Substances	Mppcf	Mg/M ³	Aerodynamic diameter (unit density sphere)	Percent passing selector
Slates:			2	80
Crystalline:			2.5	75
Quartz (respirable)	200	10mg/M ³	2.5	50
	%SiO ₂ +8	%SiO ₂ +2	5.0	25
Quartz (total dust)			10	0
Crystalline: Use 1/2 the value calculated from the count or mass formulae for quartz.				
Tridymite: Use 1/2 the value calculated from the formulae for quartz.				
Amorphous, including natural diatomaceous earth	20	20mg/M ³		
Perlite	30	%SiO ₂		
Slurries (less than 1% crystalline silica)				
Mica	20			
Soapstone	20			
Talc (non-asbestos form)	20			
Talc (fibrous): Use asbestos limit				
Tremolite (see talc, fibrous)				
Partial cement	20			
Graphite (natural)	15			
Coal dust (respirable fraction less than 5% SiO ₂)		2.5 mg/M ³		
For more than 5% SiO ₂ (use appropriate formula)				
Any fine dust		%SiO ₂ +2		
Inert or nuisance dust				
Respirable fraction	15	10mg/M ³		
Total dust	20	10mg/M ³		

NOTE: Concentration in test—

mppcf is 3.6 million particles per cubic meter

Mg/M³ is milligrams per cubic meter

* Millions of particles per cubic foot of air, based on impinger samples collected by light-field techniques

* The percentage of crystalline silica in the formula is the amount determined from air-borne samples, as reported in these instances in which other methods have been shown to be applicable

* As determined by the membrane filter method at 40°C (104°F) and 100% relative humidity

* Both fine dust and inert dust of quartz for the application of this limit are to be determined from the fraction passing a sieve No. 10 with the following characteristics

* Concentrations < 1% quartz, if < 1% quartz, use quartz limit

(c) Methods of compliance—(1) Engineering methods. (i) Engineering controls. Engineering controls, such as, but not limited to, isolation, enclosure, exhaust ventilation, and dust collection, shall be used to meet the exposure limits prescribed in paragraph (b) of this section.

(ii) Local exhaust ventilation. (a) Local exhaust ventilation and dust collection systems shall be designed, constructed, installed, and maintained in accordance with the American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, ANSI Z9.2-1971, which is incorporated by reference herein.

(b) See § 1910.6 concerning the availability of ANSI Z9.2-1971, and the maintenance of a historic file in connection therewith. The address of the American National Standards Institute is given in § 1910.100.

(iii) Particular tools. All hand-operated and power-operated tools which may produce or release asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section, such as, but not limited to, saws, scorers, abrasive wheels, and drills, shall be provided with local exhaust ventilation systems in accordance with subdivision (ii) of this subparagraph.

(2) Work practices—(i) Wet methods. Insofar as practicable, asbestos shall be handled, mixed, applied, removed, cut, scored, or otherwise worked in a wet state sufficient to prevent the emission of airborne fibers in excess of the exposure limits prescribed in paragraph (b) of this section, unless the usefulness of the product would be diminished thereby.

(ii) Particular products and operations. No asbestos cement, mortar, coating, grout, plaster, or similar material containing asbestos 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 asbestos fibers in excess of the limits prescribed in paragraph (b) of this section.

(iii) Spraying, demolition, or removal. Employees engaged in the spraying of asbestos, the removal, or demolition of pipes, structures, or equipment covered or insulated with asbestos, and in the removal or demolition of asbestos insulation or coverings shall be provided with respiratory equipment in accordance with paragraph (d) (2) (iii) of this section and with special clothing in accordance with paragraph (d) (3) of this section.

(d) Personal protective equipment—(1) Compliance with the exposure limits prescribed by paragraph (b) of this section may not be achieved by the use of respirators or shift rotation of employees, except:

(i) During the time period necessary to install the engineering controls and to institute the work practices required by paragraph (c) of this section;

(ii) In work situations in which the methods prescribed in paragraph (c) of

(a) Definitions. For the purpose of this section, (1) "Asbestos" includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite.

(2) "Asbestos fibers" means asbestos fibers longer than 5 micrometers.

(b) Permissible exposure to airborne concentrations of asbestos fibers—(1) Standard effective July 7, 1972. The 8-hour time-weighted average airborne concentrations of asbestos fibers to which any employee may be exposed shall not exceed five fibers, longer than 5 micrometers, per cubic centimeter of air, as determined by the method prescribed in paragraph (e) of this section.

(2) Standard effective July 1, 1976. The 8-hour time-weighted average airborne concentrations of asbestos fibers to which any employee may be exposed shall not exceed two fibers, longer than 5 micrometers, per cubic centimeter of air, as determined by the method prescribed in paragraph (e) of this section.

(3) Ceiling concentration. No employee shall be exposed at any time to airborne concentrations of asbestos fibers in excess of 10 fibers, longer than 5 micrometers, per cubic centimeter of air, as determined by the method prescribed in paragraph (e) of this section.

this section are either technically not feasible or feasible to an extent insufficient to reduce the airborne concentrations of asbestos fibers below the limits prescribed by paragraph (b) of this section; or

(iii) In emergencies.

(iv) Where both respirators and personnel rotation are allowed by subdivisions (i), (ii), or (iii) of this subparagraph, and both are practicable, personnel rotation shall be preferred and used.

(2) Where a respirator is permitted by subparagraph (1) of this paragraph, it shall be selected from among those approved by the Bureau of Mines, Department of the Interior, or the National Institute for Occupational Safety and Health, Department of Health, Education, and Welfare, under the provisions of 30 CFR Part 11 (37 F.R. 6244, Mar. 23, 1972), and shall be used in accordance with subdivisions (i), (ii), (iii), and (iv) of this subparagraph.

(i) *Air purifying respirators.* A reusable or single use air purifying respirator, or a respirator described in subdivision (ii) or (iii) of this subparagraph, shall be used to reduce the concentrations of airborne asbestos fibers in the respirator below the exposure limits prescribed in paragraph (b) of this section, when the ceiling or the 8-hour time-weighted average airborne concentrations of asbestos fibers are reasonably expected to exceed no more than 10 times those limits.

(ii) *Powered air purifying respirators.* A full facepiece powered air purifying respirator, or a powered air purifying respirator, or a respirator described in subdivision (iii) of this subparagraph, shall be used to reduce the concentrations of airborne asbestos fibers in the respirator below the exposure limits prescribed in paragraph (b) of this section, when the ceiling or the 8-hour time-weighted average concentrations of asbestos fibers are reasonably expected to exceed 10 times, but not 100 times, those limits.

(iii) *Type "C" supplied-air respirators, continuous flow or pressure-demand class.* A type "C" continuous flow or pressure-demand, supplied-air respirator shall be used to reduce the concentrations of airborne asbestos fibers in the respirator below the exposure limits prescribed in paragraph (b) of this section, when the ceiling or the 8-hour time-weighted average airborne concentrations of asbestos fibers are reasonably expected to exceed 100 times those limits.

(iv) *Establishment of a respirator program.* (a) The employer shall establish a respirator program in accordance with the requirements of the American National Standards Practices for Respiratory Protection, ANSI Z88.2-1969, which is incorporated by reference herein.

b. See § 1910.6 concerning the availability of ANSI Z88.2-1969 and the maintenance of an historic file in connection therewith. The address of the American National Standards Institute is given in § 1910.100.

(c) No employee shall be assigned to tasks requiring the use of respirators if,

based upon his 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 his use of a respirator. Such employee shall be rotated to another job or given the opportunity to transfer to a different position whose duties he is able to perform with the same employer, in the same geographical area and with the same seniority, status, and rate of pay he had just prior to such transfer, if such a different position is available.

(3) *Special clothing:* The employer shall provide, and require the use of, special clothing, such as coveralls or similar whole body clothing, head coverings, gloves, and foot coverings for any employee exposed to airborne concentrations of asbestos fibers, which exceed the ceiling level prescribed in paragraph (b) of this section.

(4) *Change rooms:* (i) At any fixed place of employment exposed to airborne concentrations of asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section, the employer shall provide change rooms for employees working regularly at the place.

(ii) *Clothes lockers:* The employer shall provide two separate lockers or containers for each employee, so separated or isolated as to prevent contamination of the employee's street clothes from his work clothes.

(iii) *Laundrying:* (a) Laundering of asbestos contaminated clothing shall be done so as to prevent the release of airborne asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section.

(b) Any employer who gives asbestos-contaminated clothing to another person for laundering shall inform such person of the requirement in (a) of this subdivision to effectively prevent the release of airborne asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section.

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

(e) *Method of measurement.* All determinations of airborne concentrations of asbestos fibers shall be made by the membrane filter method at 400-450 X (magnification) (4 millimeter objective) with phase contrast illumination.

(f) *Monitoring—(1) Initial determinations.* Within 6 months of the publication of this section, every employer shall cause every place of employment where asbestos fibers are released to be monitored in such a way as to determine whether every employee's exposure to asbestos fibers is below the limits prescribed in paragraph (b) of this section. If the limits are exceeded, the employer shall immediately undertake a compliance program in accordance with paragraph (c) of this section.

(2) *Personal monitoring—(1) Sam-* ples shall be collected from within the

breathing zone of the employees, on membrane filters of 0.8 micrometer porosity mounted in an open-face filter holder. Samples shall be taken for the determination of the 8-hour time-weighted average airborne concentrations and of the ceiling concentrations of asbestos fibers.

(ii) *Sampling frequency and patterns.* After the initial determinations required by subparagraph (1) of this paragraph, samples shall be of such frequency and pattern as to represent with reasonable accuracy the levels of exposure of employees. In no case shall the sampling be done at intervals greater than 6 months for employees whose exposure to asbestos may reasonably be foreseen to exceed the limits prescribed by paragraph (b) of this section.

(3) *Environmental monitoring—(1)* samples shall be collected from areas of a work environment which are representative of the airborne concentrations of asbestos fibers which may reach the breathing zone of employees. Samples shall be collected on a membrane filter of 0.8 micrometer porosity mounted in an open-face filter holder. Samples shall be taken for the determination of the 8-hour time-weighted average airborne concentrations and of the ceiling concentrations of asbestos fibers.

(ii) *Sampling frequency and patterns.* After the initial determinations required by subparagraph (1) of this paragraph, 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 6 months for employees whose exposures to asbestos may reasonably be foreseen to exceed the exposure limits prescribed in paragraph (b) of this section.

(4) *Employee observation or monitoring.* Affected employees, or their representatives, shall be given a reasonable opportunity to observe any monitoring required by this paragraph and shall have access to the records thereof.

(g) *Caution signs and labels.* (1) *Caution signs.* (i) *Posting.* Caution signs shall be provided and displayed at each location where airborne concentrations of asbestos fibers may be in excess of the exposure limits prescribed in paragraph (b) of this section. Signs shall be posted at such a distance from such a location so that an employee may read the signs and take necessary protective steps before entering the area marked by the signs. Signs shall be posted at all approaches to areas containing excessive concentrations of airborne asbestos fibers.

(ii) *Sign specifications.* The warning signs required by subdivision (i) of this subparagraph shall conform to the requirements of 20" x 14" vertical format signs specified in § 1910.145(d)(4), and to this subdivision. The signs shall display the following legend in the lower panel, with letter sizes and styles of a visibility at least equal to that specified in this subdivision.

Legend	Notation
Asbestos.....	1" Sans Serif, Gothic or Block.
Dust Hazard.....	1/4" Sans Serif, Gothic or Block.
Avoid Breathing Dust...	1/4" Gothic.
Wear Assigned Protective Equipment.	1/4" Gothic.
Do Not Remain In Area Unless Your Work Requires It.	1/4" Gothic.
Breathing Asbestos Dust May Be Hazardous To Your Health.	14 point Gothic.

Spacing between lines shall be at least equal to the height of the upper of any two lines.

(3) **Caution labels.**—(i) **Labeling.** Caution labels shall be affixed to all raw materials, mixtures, scrap, waste, debris, and other products containing asbestos fibers, or to their containers, except that no label is required where asbestos fibers have been modified by a bonding agent, coating, binder, or other material so that during any reasonably foreseeable use, handling, storage, disposal, processing, or transportation, no airborne concentrations of asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section will be released.

(ii) **Label specifications.** The caution labels required by subdivision (i) of this subparagraph shall be printed in letters of sufficient size and contrast as to be readily visible and legible. The label shall state:

CAUTION
Contains Asbestos Fibers
Avoid Creating Dust
Breathing Asbestos Dust May Cause
Serious Bodily Harm

(b) **Housekeeping.**—(i) **Cleaning.** All external surfaces in any place of employment shall be maintained free of accumulations of asbestos fibers if, with their dispersion, there would be an excessive concentration.

(3) **Waste disposal.** Asbestos waste, scrap, debris, bags, containers, equipment, and asbestos-contaminated clothing, consigned for disposal, which may produce in any reasonably foreseeable use, handling, storage, processing, disposal, or transportation airborne concentrations of asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section shall be collected and disposed of in sealed impermeable bags, or other closed, impermeable containers.

(i) **Recordkeeping.**—(1) **Exposure records.** Every employer shall maintain records of any personal or environmental monitoring required by this section. Records shall be maintained for a period of at least 3 years and shall be made available upon request to the Assistant Secretary of Labor for Occupational Safety and Health, the Director of the National Institute for Occupational Safety and Health, and to authorized representatives of either.

(2) **Employee access.** Every employee and former employee shall have reasonable access to any record required to be maintained by subparagraph (1) of this

paragraph, which indicates the employer's own exposure to asbestos fibers.

(3) **Employee notification.** Any employee found to have been exposed at any time to airborne concentrations of asbestos fibers in excess of the limits prescribed in paragraph (b) of this section shall be notified in writing of the exposure as soon as practicable but not later than 5 days of the finding. The employee shall also be timely notified of the corrective action being taken.

(j) **Medical examinations.**—(1) **General.** The employer shall provide or make available at his cost, medical examinations relative to exposure to asbestos required by this paragraph.

(2) **Preplacement.** The employer shall provide or make available to each of his employees, within 30 calendar days following his first employment in an occupation exposed to airborne concentrations of asbestos fibers, a comprehensive medical examination, which shall include, as a minimum, a chest roentgenogram (posterior-anterior 14 x 17 inches), a history to elicit symptomatology of respiratory disease, and pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second (FEV₁).

(3) **Annual examinations.** On or before January 31, 1973, and at least annually thereafter, every employer shall provide, or make available, comprehensive medical examinations to each of his employees engaged in occupations exposed to airborne concentrations of asbestos fibers. Such annual examination shall include, as a minimum, a chest roentgenogram (posterior-anterior 14 x 17 inches), a history to elicit symptomatology of respiratory disease, and pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second (FEV₁).

(4) **Termination of employment.** The employer shall provide, or make available, within 30 calendar days before or after the termination of employment of any employee engaged in an occupation exposed to airborne concentrations of asbestos fibers, a comprehensive medical examination which shall include, as a minimum, a chest roentgenogram (posterior-anterior 14 x 17 inches), a history to elicit symptomatology of respiratory disease, and pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second (FEV₁).

(5) **Recent examinations.** No medical examination is required of any employee, if adequate records show that the employee has been examined in accordance with this paragraph within the past 1-year period.

(6) **Medical records.**—(i) **Maintenance.** Employers of employees examined pursuant to this paragraph shall cause to be maintained complete and accurate records of all such medical examinations. Records shall be retained by employers for at least 20 years.

(ii) **Access.** The contents of the records of the medical examinations required by this paragraph shall be made available, for inspection and copying,

to the Assistant Secretary of Labor for Occupational Safety and Health, the Director of NIOSH, to authorized physicians and medical consultants of either of them, and, upon the request of an employee or former employee, to his physician. Any physician who conducts a medical examination required by this paragraph shall furnish to the employer of the examined employee all the information specifically required by this paragraph, and any other medical information related to occupational exposure to asbestos fibers.

§ 1910.94 Ventilation.

(a) **Abrasive blasting.**—(1) **Definitions applicable to this paragraph.**—(i) **Abrasive.** A solid substance used in an abrasive blasting operation.

(ii) **Abrasive-blasting respirator.** A continuous flow air-line respirator constructed so that it will cover the wearer's head, neck, and shoulders to protect him from rebounding abrasive.

(iii) **Blast cleaning barrel.** A complete enclosure which rotates on an axis, or which has an internal moving tread to tumble the parts, in order to expose various surfaces of the parts to the action of an automatic blast spray.

(iv) **Blast cleaning room.** A complete enclosure in which blasting operations are performed and where the operator works inside of the room to operate the blasting nozzle and direct the flow of the abrasive material.

(v) **Blasting cabinet.** An enclosure where the operator stands outside and operates the blasting nozzle through an opening or openings in the enclosure.

(vi) **Clean air.** Air of such purity that it will not cause harm or discomfort to an individual if it is inhaled for extended periods of time.

(vii) **Dust collector.** A device or combination of devices for separating dust from the air handled by an exhaust ventilation system.

(viii) **Exhaust ventilation system.** A system for removing contaminated air from a space, comprising two or more of the following elements: (a) enclosure or hood, (b) duct work, (c) dust collecting equipment, (d) exhaust, and (e) discharge stack.

(ix) **Particulate-filter respirator.** An air purifying respirator, commonly referred to as a dust or a fume respirator, which removes most of the dust, or fume from the air passing through the device.

(x) **Respirable dust.** Airborne dust in sizes capable of passing through the upper respiratory system to reach the lower lung passages.

(xi) **Rotary blast cleaning table.** An enclosure where the pieces to be cleaned are positioned on a rotating table and are passed automatically through a series of blast sprays.

(xii) **Abrasive blasting.** The forcible application of an abrasive to a surface by pneumatic pressure, hydraulic pressure, or centrifugal force.

(2) **Dust hazards from abrasive blasting.** (i) **Abrasives** and the surface coatings on the materials blasted are shattered and pulverized during blasting