

Monsanto

FROM (NAME & LOCATION):

J. C. Edwards

DATE

September 9, 1976

SUBJECT

OSHA's List of 400 Chemicals

REFERENCE

TO

R. E. Belden
J. H. Bordelon
G. L. Bartley
C. T. Cheatham
F. H. Dupre
J. R. Gibson
W. E. Groce
G. J. Guillot
H. W. Hoch
W. W. Klemme
D. R. Kretitz
R. E. McGuire
J. J. McQueeney
W. V. Marshall
L. C. Peeler
D. Roemisch
D. K. Stephens
W. W. Varnado
W. W. Wilson

CC:

W. H. Collier
R. E. Ferris
G. L. McKee
J. S. Hagood
F. C. Himes
J. L. Kilby
R. B. Kennard
S. G. Pappas

*Items checked in
red are in lab*

*W.W.
9/23/76*

Attached is OSHA's list of 400 or more potentially hazardous substances for which they have adopted current TLV's (Threshold Limit Value). These values are low, but are not to be confused with proposed standards. An example of an OSHA Standard is the Asbestos Standard which follows the Tables.

I am passing this along, both as general information, but also in order to make sure my records are complete.

Therefore, please look over this list for any chemicals which are in your area of responsibility and return a list of these chemicals to me by September 17, 1976. The chemical can be in any amount, even as an impurity.

Thank you for your cooperation.

J. C. Edwards
J. C. Edwards

JCE/dg

RSV 0011340

OCCUPATIONAL SAFETY AND HEALTH STANDARDS

SUBPART G—OCCUPATIONAL HEALTH AND ENVIRONMENTAL CONTROL

(Code of Federal Regulations, Title 29, Chapter XVII, Part 1910, 36 FR 10466, May 29, 1971; 36 FR 15104, August 13, 1971; 36 FR 23208, December 7, 1971; 37 FR 332, January 11, 1972; 37 FR 6576, March 31, 1972; 37 FR 11320, June 7, 1972; 37 FR 22139, October 18, 1972; 37 FR 24749, November 21, 1972; 38 FR 10929, May 3, 1973; 38 FR 20074, July 7, 1973, 39 FR 3755, January 29, 1974, 39 FR 12343, April 5, 1974; 39 FR 19468, June 3, 1974; 39 FR 35896, October 4, 1974; 39 FR 41848, December 3, 1974)

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:

$$E = \frac{C_1 T_1 + C_2 T_2 + \dots + C_n T_n}{8}$$

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.

(1) To illustrate the formula prescribed in subdivision (1) of this subparagraph, note that isoamyl acetate has at 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.
Two hours exposure at 75 p.p.m.
Four hours exposure at 50 p.p.m.

Substituting this information in the formula, we have

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

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

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

Where:

E_m 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_m shall not exceed unity (1).

(1) 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
Acetone (Table G-1)	500 p.p.m.	1,000 p.p.m.
2-Butanone (Table G-1)	46 p.p.m.	200 p.p.m.
Toluene (Table G-2)	46 p.p.m.	200 p.p.m.

Substituting in the formula, we have:

$$E_m = \frac{500}{1,000} + \frac{46}{200} + \frac{46}{200}$$

$$E_m = 0.500 + 0.225 + 0.225$$

$$E_m = 0.925$$

Since E_m 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 *
Acetaldehyde	200	360
Acetic acid	10	25
Acetic anhydride	5	20
Acetone	1,000	2,400
Acetonitrile	40	70
Acetylene dichloride, see 1,2-Dichloroethane		
Aerobically tetrahydrofuran	1	14
Aerobically	0.1	0.25
Acrylamide—Skin		0.3
Acrylonitrile—Skin	20	43
Aldrin—Skin		0.18
Allyl alcohol—Skin	2	5
Allyl chloride	1	3
Allyl glycidyl ether (AGE)	10	45
Allyl propyl disulfide	2	12
2-Aminonaphthalene, see Ethanolamine		
2-Aminopyridine	0.5	2
Ammonia	50	35
Ammonium sulfate (Am-mate)		15
n-Amyl acetate	100	525
sec-Amyl acetate	125	550
Aniline—Skin	5	19
Aniline (o, p-isomers)—Skin		0.5
Antimony and compounds (as Sb)		0.5
ANTU (alpha naphthylthiourea)		0.3
Arsenic and compounds (as As)		0.5
Arsine	0.05	0.2
Asinphos-methyl—Skin		0.2
Barium (soluble compounds)		0.5
p-Benzquinone, see Quinone		
Benzoyl peroxide		5
Benzyl chloride	1	5
Biphenyl, see Diphenyl		
Bisphenol A, see Diglycidyl ether		
Boron oxide		18
C Boron trifluoride	1	3
Bromine	0.1	0.7
Bromoform—Skin		0.5
Butadiene (1,3-butadiene)	1,000	2,200
Butanethiol, see Butyl mercaptan		
2-Butanone	200	590
2-Butoxy ethanol (Butyl Cellosolve)—Skin	50	240
n-Butyl acetate (n-butyl acetate)	150	710
sec-Butyl acetate	200	950
tert-Butyl acetate	200	950
Butyl alcohol	100	300
sec-Butyl alcohol	150	450
tert-Butyl alcohol	100	300
C Butylamine—Skin	5	15
C tert-Butyl chromate (as CrO ₃)—Skin		0.1
n-Butyl glycidyl ether (BGE)	50	270
*Butyl mercaptan	10	35
p-tert-Butyltoluene	10	60
Calcium arsenate		5
Calcium oxide		5
*Camphor	2	5
Carbaryl (Sevin®)		2.5
Carbon black	1,000	9,000
Carbon dioxide	50	65
Carbon monoxide		0.5
Chlordane—Skin		0.5
Chlorinated camphene—Skin		0.5
Chlorinated diphenyl oxide		0.5
*Chlorine	1	3
Chlorine dioxide	0.1	0.3
C Chlorine trioxide	0.1	0.4
C Chloroacetaldehyde	1	3
*Chloroacetophenone (phenacyl chloride)	0.05	0.3
Chlorobenzene (monochlorobenzene)	75	350
o-Chlorobenzylidene malononitrile (OCBM)	0.05	0.4
Chlorobromomethane	200	1,050
2-Chloro-1,3-butadiene, see Chloroprene		
Chloroprene		
Chlorodiphenyl (42 percent Chlorine)—Skin		1
Chlorodiphenyl (54 percent Chlorine)—Skin		0.5
1-Chloro-2,3-epoxypropane, see Epichlorohydrin		
2-Chloroethanol, see Ethylene chlorohydrin		
Chloroethylene, see Vinyl chloride		
C Chloroform (trichloromethane)	50	240
1-Chloro-1-nitropropane	20	100
Chloroform	0.1	0.7
Chloroprene (2-chloro-1,3-butadiene)—Skin	25	90

TABLE G-1—Continued

Substance	p.p.m.*	mg./M ³ *
Chromium, sol. chrome, chromous salts as Cr		0.5
Metal and insol. salts		1
Coal tar pitch volatiles (benzene soluble fraction) anthracene, BAP, phenanthrene, acridine, chrysene, pyrene		0.2
Cobalt, metal fume and dust		0.1
Copper fume		0.1
Dusts and Mists		1
Cotton dust (raw)		1
Crocidin herbicide		15
Cresol (all isomers)—Skin	5	22
Crotonaldehyde	2	6
Cumene—Skin	50	245
Cyanide (as CN)—Skin		5
Cyclohexane	300	1,050
Cyclohexanol	50	200
Cyclohexanone	50	200
Cyclohexene	300	1,015
Cyclopentadiene	75	250
2,4-D		10
DDT—Skin		1
DDVP, see Dichloromethane		
Decaborane—Skin	0.05	0.3
Demeton®—Skin		0.1
Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone)	50	240
1,2-diaminonaphthalene		
Ethylene diamine		
Diazomethane	0.2	0.4
Diborane	0.1	0.1
Dibutylphthalate		5
C o-Dichlorobenzene	50	300
p-Dichlorobenzene	75	450
Dichlorodifluoromethane	1,000	4,950
1,3-Dichloro-4,5-dimethylhydantoin		0.2
1,1-Dichloroethane	100	400
1,2-Dichloroethylene	200	780
C Dichloroethyl ether—Skin	15	50
Dichloromethane, see Methylene chloride		
Dichloromono-fluoromethane	1,000	4,200
C 1,1-Dichloro-1-nitroethane	10	60
1,2-Dichloropropane, see Propylenedichloride		
Dichlorotetrafluoroethane	1,000	7,000
Dichlorvos (DDVP)—Skin		1
Dieldrin—Skin		0.25
Diethylamine	25	75
Diethylamino ethanol—Skin	10	50
Diethyl ether, see Ethyl ether		
Difluorodibromomethane	100	580
C Diglycidyl ether (DGE)	0.5	2.5
Dihydroxybenzene, see Hydroquinone		
Diisobutyl ketone	50	290
Diisopropylamine—Skin	5	20
Dimethoxybenzene, see Methyl cellosolve		
Dimethyl acetamide—Skin	10	35
Dimethylamine	10	18
Dimethylaminobenzene, see Xylidene		
Dimethylaniline (N-dimethylaniline)—Skin	5	25
Dimethylbenzene, see Xylene		
Dimethyl 1,2-dibromo-2,2-dichloroethyl phosphaz. (Dibrom)		3
Dimethylformamide—Skin	10	30
2,6-Dimethylheptanone, see Diisobutyl ketone		
1,1-Dimethylhydrazine—Skin	0.5	1
Dimethylphthalate		5
Dimethylsulfate—Skin	1	5
Dinitrobenzene (all isomers)—Skin		1
Dinitro-o-cresol—Skin		0.2
Dinitrotoluene—Skin		1.5
Dioxane (Diethylene dioxide)—Skin	100	360
Diphenyl	0.2	1
Diphenylmethane diisocyanate (see Methylene bisphenyl isocyanate (MDI))		
Dipropylene glycol methyl ether—Skin	100	500
Di-sec. octyl phthalate (Di-2-ethylhexylphthalate)		5
Endrin—Skin		0.1
Enchlorhydrin—Skin	5	19
EPN—Skin		0.5
1,2-Epoxypropane, see Propylene oxide		
2,3-Epoxy-1-propanol, see Glycidol		

See footnotes at end of table.

TABLE G-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 (Z37.4-1969)	10 p.p.m.	25 p.p.m.	50 p.p.m.	10 minutes.
Beryllium and beryllium compounds (Z37.29-1970)	2 $\mu\text{g}/\text{M}^3$	5 $\mu\text{g}/\text{M}^3$	25 $\mu\text{g}/\text{M}^3$	30 minutes.
Cadmium fume (Z37.5-1970)	0.1 mg./M ³	3 mg./M ³		
Cadmium dust (Z37.5-1970)	0.2 mg./M ³	5 mg./M ³		
Carbon disulfide (Z37.3-1968)	20 p.p.m.	30 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.	30 p.p.m.	60 p.p.m.	5 minutes.
Ethylene dichloride (Z37.21-1969)	30 p.p.m.	100 p.p.m.	200 p.p.m.	5 minutes in any 3 hours.
Formaldehyde (Z37.16-1967)	3 p.p.m.	5 p.p.m.	10 p.p.m.	30 minutes.
Hydrogen fluoride (Z37.28-1969)	do.	do.	do.	do.
Fluoride as dust (Z37.28-1969)	2.5 mg./M ³			
Lead and its inorganic compounds (Z37.11-1969)	0.2 mg./M ³			
Methyl chloride (Z37.18-1969)	100 p.p.m.	200 p.p.m.	300 p.p.m.	5 minutes in any 3 hours.
Methylene Chloride (Z37.3-1969)	500 p.p.m.	1,000 p.p.m.	2,000 p.p.m.	5 minutes in any 2 hours.
Organic (alkyl) mercury (Z37.30-1969)	0.01 mg./M ³	0.04 mg./M ³		
Styrene (Z37.13-1969)	100 p.p.m.	200 p.p.m.	600 p.p.m.	5 minutes in any 3 hours.
Trichloroethylene (Z37.19-1967)	do.	do.	300 p.p.m.	5 minutes in any 2 hours.
Tetrachloroethylene (Z37.22-1967)	do.	do.	do.	5 minutes in any 3 hours.
Toluene (Z37.12-1967)	200 p.p.m.	300 p.p.m.	500 p.p.m.	10 minutes.
Hydrogen sulfide (Z37.2-1966)		20 p.p.m.	50 p.p.m.	10 minutes once only if no other measurable exposure occurs.
Mercury (Z37.5-1971)		1 mg./10M ³		
Chromic acid and chromates (Z37.7-1971)		do.		

TABLE G-3—MINERAL DUSTS

Substance	Mppcf*	Mg/M ³	Aerodynamic diameter (unit density sphere)	Percent passing selector
Silica:			2	90
Crystalline:			2.5	75
Quartz (respirable).....	250 [†]	10mg/M ³ =	3.5	50
		%SiO ₂ +2	5.0	25
Quartz (total dust).....		30mg/M ³	10	0
		%SiO ₂ +2		
Cristobalite. Use $\frac{1}{2}$ the value calculated from the count or mass formulae for quartz.				
Tridymite. Use $\frac{1}{2}$ the value calculated from the formulae for quartz.				
Amorphous, including natural diatomaceous earth.....	20	30mg/M ³		
		%SiO ₂		
Silicates (less than 1% crystalline silica):				
Mica.....	20			
Serpentine.....	20			
Talc (non-asbestos-form).....	20*			
Talc (fibrous). Use asbestos limit.				
Tremolite (see talc, fibrous)				
Portland cement.....	50			
Graphite (natural).....	15			
Coal dust (respirable fraction less than 8% SiO ₂).....		2 mg/M ³ or 10mg/M ³		
For more than 8% SiO ₂		%SiO ₂ +2		
Inert or Nuisance Dust:				
Respirable fraction.....	15	5mg/M ³		
Total dust.....	50	15mg/M ³		

NOTE: Conversion factors—
 mppcf $\times 35.3$ = million particles per cubic meter
 * particles per c.c.

* Millions of particles per cubic foot of air, based on impinger samples counted by light-field technique.

† 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.

‡ As determined by the membrane filter method at 430X phase contrast magnification.

§ 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:

• Containing < 1% quartz; if > 1% quartz, use quartz limit.

The measurements under this note refer to the use of an AEC instrument. If 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 4.8 Mg/M³.

§ 1910.93a Asbestos.

(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 (c) 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 (c) 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 (c) of this section.

(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

TABLE G-1—Continued

Substance	p.p.m.*	mg./M ³ *
Ethanethiol, see Ethylmer-		
Gasum	3	6
Ethanolamine	200	740
2-Ethoxyethanol—Skin	100	340
2-Ethoxyethylacetate (Cello-	400	1,400
solvent acetate)—Skin	25	100
Ethyl acetate	1,000	1,900
Ethyl alcohol (ethanol)	10	18
Ethylamine	25	130
Ethyl sec-amyl ketone (5-	100	435
methyl-3-heptanone)	200	890
Ethyl benzene	50	230
Ethyl bromide	1,000	2,500
Ethyl butyl ketone (5-	1,000	1,700
heptanone)	100	300
Ethyl chloride	10	28
Ethyl ether	100	450
Ethyl formate	5	18
C Ethyl mercaptan	10	25
Ethyl silicate	100	450
Ethylene chlorohydrin—Skin	5	18
Ethylenediamine	10	25
Ethylene dibromide, see 1,2-		
Dibromomethane		
Ethylene dichloride, see 1,2-		
Dichloroethane		
C Ethylene glycol dinitrate	0.2	1
and/or Nitroglycerin—Skin		
Ethylene glycol monomethyl		
ether acetate, see Methyl		
cellulosolve acetate		
Ethyleneimine—Skin	0.5	1
Ethylene oxide	50	90
Ethylidene chloride, see 1,1-		
Dichloroethane		
N-Ethylmorpholine—Skin	20	94
Perbam		15
Fluoride (as F)	0.1	2.5
Fluorine	1,000	3,600
Fluorotrichloromethane	1,000	3,600
Formic acid	5	9
Furfural—Skin	5	20
Furfuryl alcohol	50	200
Glycidol (2,3-Epoxy-1-		
propanol)	20	150
Glycol monomethyl ether, see		
2-Ethoxyethanol		
Guthion (S, see Aisophos-		
methy)		
Hafnium		0.6
Heptachlor—Skin		0.6
Heptane (n-heptane)	500	2,000
Hexachlorocyclopentadiene—Skin	1	10
Hexachloronaphthalene—Skin	1	0.2
Hexane (n-hexane)	500	1,800
2-Hexanone	100	410
Hexone (Methyl isobutyl		
ketone)	100	410
sec-Hexyl acetate	40	300
Hydrazine—Skin	1	1.3
Hydrogen bromide	3	10
C Hydrogen chloride	3	7
Hydrogen cyanide—Skin	10	11
Hydrogen peroxide (30%)	1	1.4
Hydrogen selenide	0.05	0.2
Hydroquinone	2	2
C Iodine	0.1	0.15
Iron oxide fume		10
Isomyl acetate	100	325
Isomyl alcohol	100	360
Isobutyl acetate	150	700
Isobutyl alcohol	100	300
Isophorone	25	140
Isopropyl acetate	250	930
Isopropyl alcohol	400	980
Isopropylamine	5	13
Isopropyl ether	800	2,100
Isopropyl glycidyl ether (IGE)	40	240
Ketane		0.5
Lead arsenate		0.15
Lindane—Skin		0.5
Lithium hydride		0.025
L.P.G. (liquefied petroleum		
gas)	1,000	1,800
Malachion—Skin		15
Maleic anhydride	0.25	1
C Manganese		5
Mesityl oxide	25	100
Methanethiol, see Methyl		
mercaptan		
2-Methoxyethanol, see Methyl		
cellulosolve		
Methyl acetate	200	610
Methyl acrylate (propyne)	1,000	1,650
Methyl acrylate-propadiene		
mixture (MAPP)	1,000	1,800
Methyl amyl alcohol—Skin	10	35
Methylal (dimethoxymethane)	1,000	3,100
Methyl alcohol (methanol)	200	260
Methylamine	10	12
Methyl amyl alcohol, see		
Methyl isobutyl carbinal		

TABLE G-1—Continued

Substance	p.p.m.*	mg./M ³ *
Methyl (n-amyl) ketone (2-		
heptanone)	100	405
C Methyl bromide—Skin	20	80
Methyl butyl ketone, see 2-		
Hexanone	25	90
Methyl cellosolve—Skin	25	120
Methyl cellosolve acetate—Skin	350	1,000
Methyl chloroform	800	2,000
Methylcyclohexane	100	470
o-Methylcyclohexanone—Skin	100	460
Methyl ethyl ketone (M.E.K.),		
see 2-Butanone		
Methyl formate	100	250
Methyl iodide—Skin	5	20
Methyl isobutyl ketone—Skin	25	100
Methyl isobutyl ketone, see		
Isomyl		
Methyl isocyanate—Skin	0.02	0.05
C Methyl mercaptan	10	20
Methyl methacrylate	100	410
Methyl propyl ketone, see 2-		
Hexanone		
C Methyl styrene	100	480
C Methylene bisphenyl		
isocyanate (MDI)	0.02	0.2
Molybdenum:		
—Soluble compounds		15
—Insoluble compounds		5
Monomethylamine	5	9
C Monomethyl hydrazine—		
Skin	0.2	0.35
Morpholine—Skin	20	70
Naphtha (coal tar)	100	400
Naphthalene	10	80
Nickel carbonyl	0.001	0.007
Nickel, metal and soluble		
compds. as Ni		1
Nicotine—Skin	2	0.6
Nitric acid	25	30
Nitrite oxide	1	6
p-Nitroaniline—Skin	1	1
Nitrobenzene—Skin	1	1
p-Nitrochlorobenzene—Skin	100	310
Nitrogen dioxide	5	9
Nitrogen trifluoride	10	29
Nitrochloroform—Skin	0.2	2
Nitromethane	100	250
1-Nitropropane	25	90
2-Nitropropane	5	30
Nitrochloromethane, see		
Chloroform		
Octachloronaphthalene—Skin		0.1
Octane	500	2,350
Oil mist, mineral		1
Osmium tetroxide		0.002
Oxalic acid	0.05	0.1
Oxone	0.1	0.2
Parquat—Skin		0.3
Parathion—Skin		0.01
Pentachlorane	0.005	0.01
Pentachloronaphthalene—Skin		0.6
Pentachlorophenol—Skin	1,000	2,950
Pentachlorophenol	200	700
2-Pentanol	100	300
Perchloromethyl mercaptan	0.1	0.8
Perchloryl fluoride	3	13.6
Petroleum distillates (naphtha)	300	2,000
Phenol—Skin	5	19
p-Phenylenediamine—Skin		0.1
Phenyl ether (vapor)		7
Phenyl ether-bisphenyl		
mixture (vapor)	1	7
Phenylethylene, see Styrene		
Phenyl glycidyl ether (PGE)	10	80
Phenylhydrazine—Skin	5	22
Phosgene (Mevinphos &)—		
Skin	0.1	0.1
Phosgene (carbonyl chloride)	0.1	0.4
Phosphine	0.3	0.4
Phosphoric acid		1
Phosphorus (yellow)		0.1
Phosphorus pentachloride		1
Phosphorus pentasulfide		1
Phosphorus trichloride	0.5	3
Phthalic anhydride	2	12
Picric acid—Skin		0.1
Pivalic acid (2-Pivalyl-1-		
indandione)		0.1
Platinum (Soluble Salt) as		
Pt.		0.002
Propargyl alcohol—Skin		1
Propene	1,000	1,800
n-Propyl acetate	200	840
Propyl alcohol	300	600
n-Propyl nitrate	25	110
Propylene dichloride	75	360
Propyleneimine—Skin	2	8
Propylene oxide	100	240
Propyne, see Methylacetylene		
Pteridine		8
Pyridine	5	16
Quinone	0.1	0.4
RDX—Skin		1.5

TABLE G-1—Continued

Substance	p.p.m.*	mg./M ³ *
Rhodium, Metal fume and		
dusts, as Rh		0.1
Soluble salts		0.001
Ronnel		10
Rotenone (commercial)		5
Selenium compounds (as Se)		0.2
Selenium hexafluoride	0.05	0.4
Silver, metal and soluble com-		
pounds		0.01
Sodium fluoroacetate (1080)—		
Skin		0.05
Sodium hydroxide		2
Stibine	0.1	0.5
Stoddard solvent	800	2,800
Styrene		0.15
Sulfur dioxide		12
Sulfur hexafluoride	1,000	6,000
Sulfuric acid		1
Sulfur monochloride	1	6
Sulfur pentasulfide, see Fer-		
chlorosulfuric acid		0.025
Synsorb, see Demeton @		5
2,4,5-T		10
Tantalum		5
Tellurium—Skin		0.2
Tellurium hexafluoride	0.02	0.1
Tellurium pentasulfide		0.2
Tellurium tetrachloride		0.05
Tellurium trioxide		9
1,1,1,2-Tetrachloro-2,2-difluoro-		
ethane	500	4,170
1,1,2,2-Tetrachloro-1,2-difluoro-		
ethane	800	4,170
1,1,2,2-Tetrachloroethane—Skin	5	35
Tetrachloroethylene, see Fer-		
chlorosulfuric acid		
Tetrachloromethane, see Cusum		
tetrachloride		
Tetrachlorophthalene—Skin		2
Tetraethyl lead (as Pb)—Skin		0.075
Tetrahydrofuran	200	840
Tetrahydrofuran (as Pb)—		
Skin		0.07
Tetramethyl succinonitrile—		
Skin	0.5	3
Tetranitromethane	1	8
Tetryl (2,4,6-trinitrophenyl-		
methylinitramine)—Skin		1.8
Thallium (soluble com-		
pounds)—Skin as Tl		0.1
Thiram		5
Thi (inorganic compds. except		
oxides)		2
Tin (organic compds.)		0.1
C Toluene-2,4-dithiocyanate	0.02	0.14
o-Toluidine—Skin	5	22
Toraphene, see Chlorinated		
hydrocarbons		
Triethyl phosphite		5
1,1,1-Trichloroethane see		
Methyl chloroform		
1,1,2-Trichloroethane—Skin	10	48
Titanium dioxide		15
Trichloromethane, see Chloro-		
form		
Trichloroethylene—Skin		5
1,2,3-Trichloropropane	30	300
1,1,2-Trichloro 1,2,2-trifluoro-		
ethane	1,000	7,000
Triethylamine	25	100
Trifluoromonomomomomethane	1,000	6,100
2,4,6-Trinitrophenol, see Picric		
acid		
2,4,6-Trinitrophenylmethyl-		
nitramine, see Tetryl		
Trinitrotoluene—Skin		1.5
Trichloroethyl phosphite		3
Triphenyl phosphite	100	680
Turpentine		0.05
Uranium (soluble compounds)		0.25
Uranium (insoluble compounds)		
C Vanadium:		
-V ₂ O ₅ dust		0.5
-V ₂ O ₅ fume		0.1
Vinyl benzene, see Styrene		
Vinylcyanide, see Acrylonitrile		
Vinyl toluene	100	450
Warfarin		0.1
Xylene (xytol)	100	450
Xylidine—Skin	5	25
Yttrium		1
Zinc chloride fume		5
Zinc oxide fume		5
Zirconium compounds (as Zr)		5

*1970 Addition.
 * Parts of vapor or gas per million parts of contami-
 nated air by volume at 25° C. and 760 mm. Hg pressure.
 * Approximate milligrams of particulate per cubic
 meter of air.
 (No footnote "c" is used to avoid confusion with
 ceiling value notations.)
 * An atmospheric concentration of not more than
 0.02 p.p.m., or personal protection may be necessary
 to avoid headaches.
 * As sampled by method that does not collect vapor.
 * For control of general room air, biologic monitoring
 is essential for personnel control.
 [Vinyl chloride deleted at 39 FR 11343,
 April 5, 1974]

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:

(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 Director 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 FR 6244, Mar. 25, 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 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 competence 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) Laundrying 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.*

(d) *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.* (i) Samples shall be collected from within the breathing zone of the employee, 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 pattern.* After the initial determinations required by subparagraph (1) of this paragraph, samples shall be of such frequency 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.* 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 pattern.* After the initial determinations required by subparagraph (1) of this paragraph, samples shall be of such frequency pattern as to represent with reasonable accuracy the levels of exposure of employees. In no case shall sampling be at intervals greater than 6 months for employees whose exposure to asbestos may reasonably be foreseen to exceed the exposure limits prescribed in paragraph (b) of this section.

(4) *Employee observation of 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 (1) 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.....	¾" Sans Serif, Gothic or Block.
Avoid Breathing Dust... Wear Assigned Protective Equipment.	½" Gothic.
Do Not Remain In Area Unless Your Work Requires It.	½" Gothic.

Legend
Breathing Apparatus Must Be Worn Wherever There May Be Hazardous To Your Health.

Notation

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

(2) **Caution label.**—(i) **Letting Caution labels** shall be affixed to all raw materials, intermediate forms, 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 Apparatus Must Be Worn Where There May Be Hazardous To Your Health

(h) **Housekeeping.**—(1) **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.

(2) **Waste disposal.** Asbestos waste, sp. 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 20 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.

[1910.1001(h)(1) amended at 41 FR 11505, March 19, 1976]

(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 employee'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 30 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.**—(1) **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.

(2) **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.

§ 1910.1002 Coal tar pitch volatiles in interpretation of term.

As used in Sec. 1910.1000 (Table Z-1, coal tar pitch volatiles) include the fused polycyclic hydrocarbons which volatilize from the distillation residues of coal, petroleum, wood, and other organic materials.

[37 FR 24749 Effective November 21, 1972]

§ 1910.1003 4-Nitrophenyl. (1) This section applies to any area in which 4-Nitrophenyl. Chemical Abstracts Service Registry Number 92933 is manufactured, processed, repackaged, released, handled, or stored, but shall not apply to transshipment in sealed containers, except for the labeling requirements under paragraphs (e) (2), (3), and (4) of this section.

§ 1910.1003 4-Nitrophenyl.

(a) **Scope and application.** (1) This section applies to any area in which 4-Nitrophenyl. Chemical Abstracts Service Registry Number 92933 is manufactured, processed, repackaged, released, handled, or stored, but shall not apply to transshipment 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-Nitrophenyl.

(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.

(3) "Clean change room" means a room where employees put on clean clothing and/or protective equipment in an environment free of 4-Nitrophenyl. The clean change room shall be contiguous to and have an entry from a shower room, when the shower room facilities are otherwise required in this section.

(4) "Closed system" means an operation involving 4-Nitrophenyl where containment prevents the release of 4-Nitrophenyl into regulated areas, non-regulated areas, or the external environment.

(5) "Decontamination" means the inactivation of 4-Nitrophenyl or its safe disposal.

(6) "Director" means the Director, National Institute for Occupational Safety and Health, or any person directed by him or the Secretary of Health, Education, and Welfare to act for the Director.

(7) "Disposal" means the safe removal of 4-Nitrophenyl from the work environment.

(8) "Emergency" means an unforeseen circumstance or set of circumstances resulting in the release of 4-Nitrophenyl which may result in exposure to or contact with 4-Nitrophenyl.

(9) "External environment" means any environment external to regulated and nonregulated areas.

(10) "Isolated system" means a fully enclosed structure other than the vessel of containment of 4-Nitrophenyl, which is impervious to the passage of 4-Nitrophenyl, and which would prevent