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INTERNAL LETTERHEAD

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TO (NAME AND LOCATION) See attached list		REFERENCE NO.
FROM (NAME AND LOCATION) Mr. Charles S. Laubly - New York	REFERENCE NO. CSL:75-10	DATE 9-5-75

This copy of Guidelines for Industrial Hygiene is submitted to acquaint you with our recommended practices and procedures for monitoring worker exposures to solvent vapors and gases in our plants. The procedures outlined are consistent with good industrial hygiene practice and meet the present requirements of OSHA.

The Corporate Medical Department will be glad to assist you in implementing the monitoring program in your plant. We would appreciate any information regarding the monitoring program presently in force in your plant.



Charles S. Laubly
Corporate Manager
Industrial Hygiene

CSL:rd
Att.

GUIDELINES FOR INDUSTRIAL HYGIENE

The added emphasis on occupational health in OSHA brought upon, in part, by the asbestos, carcinogen and vinyl chloride standards means that we are going to have to do more monitoring at the plant level.

The Corporate Medical Department has made plant surveys to determine exposures to noise, dusts, fumes and solvent vapors, and will continue to aid in evaluating any exposure that presents a potential occupational disease hazard. However, the Corporate Medical Department cannot carry on the complete monitoring program prescribed by the OSHA standards--this must be done at the local level.

Public Law 91-596 better known as the "Occupational Safety and Health Act of 1970" at the present time requires monitoring only for exposures to asbestos (1910.93a) and vinyl chloride (1910.93q). However, in Section 5 (a) of the Act, it is implied that each employer should determine the level of exposure of each employee to workroom contaminants. To be more specific Section 5 (a) of the Act states that "Each employer shall --

- (1) furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees;
- (2) comply with occupational safety and health standards promulgated under this Act".

Section 5 (b) of the Act states that "Each employee shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this Act which are applicable to his own actions and conduct.

In addition, Subpart G - Occupational Health and Control, 1910.93, Air Contaminants of the Rules and Regulations states that, "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". (See attached pages 1-6).

Many of our plants have been monitoring the workplaces where there are exposures to materials covered by the present standards and to those materials presently in Tables G-1, G-2 and G-3. In most instances, where a monitoring program has been established, the Corporate Medical Department has been instrumental in implementing the program and will continue to do so. However, it is not possible for the Corporate Medical Department to have on-going programs for each plant. Therefore, it is suggested that the following guidelines be used to conduct the monitoring programs at our plants:

1. Chemical indicator tubes certified by NIOSH may be used for determining exposures to those materials in Tables G-1 and G-2. Indicator tube suppliers such as Dräger, Gastec and Mine Safety Appliances supply NIOSH certified tubes for materials such as CO, CO₂, Cl, H₂S, NH₃ and NO₂, to mention a few. However, in most situations, until chemical indicator tubes are designated as a satisfactory monitoring device by an OSHA standard, the tubes should be used only as a means to identify a problem and not as an analytical tool.

At the present time some industrial hygienists are using chemical indicator tubes for evaluating exposures to materials found in Tables G-1 and G-2. However, these evaluations are made only after a specific tube has been calibrated for the material involved. Until such time that we can calibrate chemical indicator tubes, or NIOSH certified calibrated tubes are commercially available, any chemical indicator tube should be used only in the manner stated in the paragraph (1) above.

2. Worker exposures monitored and evaluated by methods consistent with good industrial hygiene practice should be the ultimate goal of our monitoring programs. As mentioned previously, the Corporate Medical Department will assist the Celanese plants in their surveillance of occupational health hazards by initial surveys and periodic evaluations of exposures, but routine monitoring is best done on a regular basis by plant personnel selected by management from among those most knowledgeable and in keeping within their work assignments.
3. Plants conducting or planning their own monitoring programs should contact the Corporate Medical Department for guidance relative to acceptable industrial hygiene procedures.
4. Analytical work for monitoring programs is best done on site, but in most instances this is not possible. At the present time most of the analytical work is done by a laboratory accredited by the American Industrial Hygiene Association. Any proposed analytical work for industrial hygiene evaluations should be reviewed by the Corporate Medical Department to assure that the methods of analysis are consistent with good industrial hygiene practice.

Two of our laboratories have expressed an interest in accreditation by the American Industrial Hygiene Association; but until such time that these laboratories are accredited, any analytical services for industrial hygiene monitoring which includes sampling methods and laboratory procedures should be reviewed by the Corporate Medical Department.

5. The attached sampling sheet is a suggested form for recording the data significant for an industrial hygiene monitoring program.

If you have any questions or comments, please contact the Corporate Manager, Industrial Hygiene.

(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.

TABLE G-1

Substance	p.p.m. ^a	mg./M ³ ^b
Acetaldehyde.....	200	360
Acetic acid.....	10	25
Acetic anhydride.....	5	20
Acetone.....	1,000	2,400
Acetonitrile.....	40	70
Acetylene dichloride, see 1, 2-Dichloroethylene.....		
Acetylene tetrabromide.....	1	14
Acrolein.....	0.1	0.25
Acrylamide—Skin.....		0.3
Acrylonitrile—Skin.....	20	45
Aldrin—Skin.....		0.25
Allyl alcohol—Skin.....	2	5
Allyl chloride.....	1	3
**C Allylglycidyl ether (AGE).....	10	45
Allyl propyl disulfide.....	2	12
2-Aminoethanol, see Ethanol-amine.....		
2-Aminopyridine.....	0.5	2
**Ammonia.....	50	35
Ammonium sulfamate (Am-mate).....		15
n-Amyl acetate.....	100	525
sec-Amyl acetate.....	125	650
Aniline—Skin.....	5	19
Anisidine (o, p-isomers)—Skin.....		0.5
Antimony and compounds (as Sb).....		0.5
ANTU (alpha naphthyl thiourea).....		0.3
Arsenic and compounds (as As).....		0.5
Arsine.....	0.05	0.2
Azinphos-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.....		15
C Boron trifluoride.....	1	3
Bromine.....	0.1	0.7
Bromoform—Skin.....	0.5	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
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.....		1
Calcium oxide.....		5
**Camphor.....	2	
Carbaryl (Sevin®).....		5
Carbon black.....		3.5
Carbon dioxide.....	5,000	9,000
Carbon monoxide.....	50	55
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 trifluoride.....	0.1	0.4
C Chloroacetaldehyde.....	1	3
α-Chloroacetophenone (phenacylchloride).....	0.05	0.3
Chlorobenzene (monochlorobenzene).....	75	350
o-Chlorobenzylidene malonitrile (OCBM).....	0.05	0.4
Chlorobromomethane.....	200	1,050
2-Chloro-1,3-butadiene, see 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
Chloropicrin.....	0.1	0.7
Chloroprene (2-chloro-1,3-butadiene)—Skin.....	25	90
Chromium, sol. chromic, 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
Crag® herbicide.....		15
Cresol (all isomers)—Skin.....	5	22
Crotonaldehyde.....	2	6
Cumene—Skin.....	60	245
Cyanide (as CN)—Skin.....		5
Cyclohexane.....	300	1,050
Cyclohexanol.....	60	200
Cyclohexanone.....	60	200
Cyclohexene.....	300	1,015
Cyclopentadiene.....	75	200
2, 4-D.....		10
DDT—Skin.....		1
DDVP, see Dichlorvos.....		
Decahorane—Skin.....	0.05	0.3
Demeton®—Skin.....		0.1
Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone).....	60	240
1,2-diaminoethane, see Ethylenediamine.....		
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-5,5-dimethyl hydantoin.....		0.2
1,1-Dichloroethane.....	100	400
1,2-Dichloroethylene.....	200	790
C Dichloroethyl ether—Skin.....	15	90
Dichloromethane, see Methylenechloride.....		
Dichloromonofluoromethane.....	1,000	4,200
C 1,1-Dichloro-1-nitroethane.....	10	60
1,2-Dichloropropane, see Propylenedichloride.....		

TABLE G-1—Continued

Substance	p.p.m. ^a	mg./M ³ ^b
Dichlorotetrafluoroethane.....	1,000	7,000
Dichlorvos (DDVP)—Skin.....		1
Dieldrin—Skin.....		0.25
Diethylamine.....	25	75
Diethylamino ethanol—Skin.....	10	60
Diethylether, see Ethyl ether.....		
Difluorodibromomethane.....	100	860
C Diglycidyl ether (DGE).....	0.5	2.8
Dihydroxybenzene, see Hydroquinone.....		
Diisobutyl ketone.....	50	290
Diisopropylamine—Skin.....	5	20
Dimethoxymethane, see Methylal.....		
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 phosphate, (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	600
Di-sec. octyl phthalate (Di-2-ethylhexylphthalate).....		5
Endrin—Skin.....		0.1
Epichlorhydrin—Skin.....	5	19
EPN—Skin.....		0.6
1,2-Epoxypropane, see Propyleneoxide.....		
2,3-Epoxy-1-propanol, see Glycidol.....		
Ethanethiol, see Ethylmercaptan.....		
Ethanolamine.....	3	6
2-Ethoxyethanol—Skin.....	200	740
2-Ethoxyethylacetate (Cellulosolve acetate)—Skin.....	100	540
Ethyl acetate.....	400	1,400
Ethyl acrylate—Skin.....	25	100
Ethyl alcohol (ethanol).....	1,000	1,900
Ethylamine.....	10	18
Ethyl sec-amy! ketone (5-methyl-3-heptanone).....	25	130
Ethyl benzene.....	100	435
Ethyl bromide.....	200	890
Ethyl butyl ketone (3-Heptanone).....	50	230
Ethyl chloride.....	1,000	2,600
Ethyl ether.....	400	1,200
Ethyl formate.....	100	300
C Ethyl mercaptan.....	10	25
Ethyl silicate.....	100	850
Ethylene chlorohydrin—Skin.....	5	16
Ethylenediamine.....	10	25
Ethylene dibromide, see 1,2-Dibromoethane.....		
Ethylene dichloride, see 1,2-Dichloroethane.....		
C Ethylene glycol dinitrate and/or Nitroglycerin—Skin.....	40.2	1
Ethylene glycol monomethyl ether acetate, see Methyl cellosolve acetate.....		
Ethyleneimine—Skin.....	0.5	1
Ethylene oxide.....	50	90
Ethylidene chloride, see 1,1-Dichloroethane.....		
N-Ethylmorpholine—Skin.....	20	94
Ferbam.....		15
Ferrovandium dust.....		1
Fluoride (as F).....		2.5
Fluorine.....	0.1	0.2
Fluorotrichloromethane.....	1,000	5,600
Formic acid.....	5	9
Furfural—Skin.....	5	20
Furfuryl alcohol.....	50	200
Glycidol (2,3-Epoxy-1-propanol).....	50	150
Glycol monoethyl ether, see 2-Ethoxyethanol.....		
Guthion ®, see Azinphos-methyl.....		
Hafnium.....		0.5
Heptachlor—Skin.....		0.5
Heptane (n-heptane).....	500	2,000
Hexachloroethane—Skin.....	1	10
Hexachloronaphthalene—Skin.....		0.2
Hexane (n-hexane).....	500	1,800
2-Hexanone.....	100	410
Hexone (Methyl isobutyl ketone).....	100	410
sec-Hexyl acetate.....	50	300
Hydrazine—Skin.....	1	1.3
Hydrogen bromide.....	3	10
C Hydrogen chloride.....	5	7
Hydrogen cyanide—Skin.....	10	11
Hydrogen peroxide (90%).....	1	1.4
Hydrogen selenide.....	0.05	0.2
Hydroquinone.....		2
C Iodine.....	0.1	1
Iron oxide fume.....		10
Isoamyl acetate.....	100	525
Isoamyl alcohol.....	100	360
Isobutyl acetate.....	150	700
Isobutyl alcohol.....	100	300
Isophorone.....	25	140
Isopropyl acetate.....	250	950
Isopropyl alcohol.....	400	980
Isopropylamine.....	5	12
Isopropylether.....	500	2,100
Isopropyl glycidyl ether (IGE).....	50	240
Ketene.....	0.5	0.9
Lead arsenate.....		0.15
Lindane—Skin.....		0.5
Lithium hydride.....		0.025
L.P.G. (liquefied petroleum gas).....	1,000	1,800
Magnesium oxide fume.....		15
Malathion—Skin.....		15
Maleic anhydride.....	0.25	1
C Manganese.....		5
Mesityl oxide.....	25	100
Methanethiol, see Methyl mercaptan.....		
Methoxychlor.....		15
2-Methoxyethanol, see Methyl cellosolve.....		
Methyl acetate.....	200	610
Methyl acetylene (propyne).....	1,000	1,650
Methyl acetylene-propadiene mixture (MAPP).....	1,000	1,800
Methyl acrylate—Skin.....	10	35
Methylal (dimethoxymethane).....	1,000	3,100
Methyl alcohol (methanol).....	200	260
Methylamine.....	10	12
Methyl amyl alcohol, see Methyl isobutyl carbinol.....		
Methyl (n-amy!) ketone (2-Heptanone).....	100	445
C Methyl bromide—Skin.....	20	80
Methyl butyl ketone, see 2-Hexanone.....		
Methyl cellosolve—Skin.....	25	80
Methyl cellosolve acetate—Skin.....	25	120
Methyl chloroform.....	350	1,900
Methylcyclohexane.....	500	2,000
Methylcyclohexanol.....	100	470

See footnotes at end of table.

TABLE G-1—Continued

Substance	p.p.m.*	mg./M ¹ b
o-Methylcyclohexanone—Skin..	100	480
Methyl ethyl ketone (MEK), see 2-Butanone.....		
Methyl formate.....	100	250
Methyl iodide—Skin.....	5	28
Methyl isobutyl carbinol—Skin.....	25	100
Methyl isobutyl ketone, see Hexone.....		
Methyl isocyanate—Skin.....	0.02	0.05
C Methyl mercaptan.....	10	20
Methyl methacrylate.....	100	410
Methyl propyl ketone, see 2- Pentanone.....		
C α Methyl styrene.....	100	480
C Methylene bisphenyl isocyanate (MDI).....	0.02	0.2
Molybdenum:		
Soluble compounds.....		5
Insoluble compounds.....		15
Monomethyl aniline—Skin.....	2	9
C Monomethyl hydrazine— Skin.....	0.2	0.34
Morpholine—Skin.....	20	70
Naphtha (coal tar).....	100	400
Naphthalene.....	10	50
Nickel carbonyl.....	0.001	0.007
Nickel, metal and soluble cmpds, as Ni.....		1
Nicotine—Skin.....		0.5
Nitric acid.....	2	5
Nitric oxide.....	25	30
n-Nitroaniline—Skin.....	1	5
Nitrobenzene—Skin.....	1	5
p-Nitrochlorobenzene—Skin.....		1
Nitroethane.....	100	310
Nitrogen dioxide.....	5	9
Nitrogen trifluoride.....	10	29
Nitroglycerin—Skin.....	0.2	2
Nitromethane.....	100	250
1-Nitropropane.....	25	90
2-Nitropropane.....	25	90
Nitrotoluene—Skin.....	5	30
Nitrotrichloromethane, see Chloropicrin.....		
Octachloronaphthalene—Skin.....		0.1
*Octane.....	500	2,350
*Oil mist, mineral.....		5
Osmium tetroxide.....		0.002
Oxalic acid.....		1
Oxygen difluoride.....	0.05	0.1
Ozone.....	0.1	0.2
Paraquat—Skin.....		0.5
Parathion—Skin.....		0.1 1
Pentaborane.....	0.005	0.01
Pentachloronaphthalene—Skin.....		0.5
Pentachlorophenol—Skin.....		0.5
*Pentane.....	1,000	2,950
2-Pentanone.....	200	700
Perchloromethyl mercaptan.....	0.1	0.8
Perchloryl fluoride.....	3	13.5
Petroleum distillates (naphtha). Phenol—Skin.....	500	2,000
p-Phenylene diamine—Skin.....	5	19
Phenyl ether (vapor).....		0.1
Phenyl ether-biphenyl mixture (vapor).....	1	7
Phenylethylene, see Styrene.....		
Phenylglycidyl ether (PGE).....	10	60
Phenylhydrazine—Skin.....	5	22
Phosdrin (Mevinphos ®)— Skin.....		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
Pival ® (2-Pivalyl-1,3- indandione).....		0.1
Platinum (Soluble Salts) as Pt.....		0.002
Propargyl alcohol—Skin.....	1	
Propane.....	1,000	1,800
n-Propyl acetate.....	200	840
Propyl alcohol.....	200	500
n-Propyl nitrate.....	25	110
Propylene dichloride.....	75	350
Propylene imine—Skin.....	2	5
Propylene oxide.....	100	240
Propyne, see Methylacetylene.....		
Pyrethrum.....		5
Pyridine.....	5	15
Quinone.....	0.1	0.4
RDX—Skin.....		1.5
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 fluoracetate (1080)— Skin.....		0.05
Sodium hydroxide.....		2
Stibine.....	0.1	0.5
*Stoddard solvent.....	500	2,950
Strychnine.....		0.15
Sulfur dioxide.....	5	13
Sulfur hexafluoride.....	1,000	6,000
Sulfuric acid.....		1
Sulfur monochloride.....	1	5
Sulfur pentafluoride.....	0.025	0.25
Sulfuryl fluoride.....	5	20
Systox, see Demeton ®.....		
2,4,5T.....		10
Tantalum.....		5
TEBP—Skin.....		0.2
Tellurium.....		0.1
Tellurium hexafluoride.....	0.02	0.2
TEPP—Skin.....		0.05
C Terphenyls.....	1	9
1,1,1,2-Tetrachloro-2,2-difluoro- ethane.....	500	4,170
1,1,2,2-Tetrachloro-1,2-difluoro- ethane.....	500	4,170
1,1,2,2-Tetrachloroethane—Skin.....	5	35
Tetrachloroethylene, see Per- chloroethylene.....		
Tetrachloromethane, see Carbon tetrachloride.....		
Tetrachloronaphthalene—Skin.....		2
Tetraethyl lead (as Pb)—Skin.....		0.075
Tetrahydrofuran.....	200	590
Tetramethyl lead (as Pb)— Skin.....		0.07
Tetramethyl succinonitrile— Skin.....	0.5	3
Tetranitromethane.....	1	8
Tetryl (2,4,6-trinitrophenyl- methylnitramine)—Skin.....		1.5
Thallium (soluble com- pounds)—Skin as Tl.....		0.1
Thiram.....		5
Ti (Inorganic cmpds, except oxides).....		2
Ti (Organic cmpds).....		0.1
C Toluene-2,4-dithiocyanate.....	0.02	0.14
o-Toluidine—Skin.....	5	22
Toxaphene, see Chlorinated camphene.....		
Tributyl phosphate.....		5
1,1,1-Trichloroethane see Methyl chloroform.....		
1,1,2-Trichloroethane—Skin.....	10	45
Titaniumdioxide.....		15
Trichloromethane, see Chloro- form.....		
Trichloronaphthalene—Skin.....		5
1,2,3-Trichloropropane.....	50	300
1,1,2-Trichloro 1,2,2-trifluoro- ethane.....	1,000	7,600
Triethylamine.....	25	100
Trifluoromonobromomethane.....	1,000	6,100
2,4,6-Trinitrophenol, see Picric acid.....		

TABLE G-1—Continued

Substance	p.p.m.*	mg./M ^b
2,4,6-Trinitrophenylmethyl-nitramine, see Tetryl.....		1.6
Trinitrotoluene—Skin.....		0.1
Triorthocresyl phosphate.....		3
Triphenyl phosphate.....		560
Turpentine.....	100	0.05
Uranium (soluble compounds).....		0.25
Uranium (insoluble compounds).....		0.6
C Vanadium:		0.1
V ₂ O ₅ dust.....		0.1
V ₂ O ₅ fume.....		1,300
Vinyl benzene, see Styrene.....		480
**C Vinyl chloride.....	500	0.1
Vinylcyanide, see Acrylonitrile.....		435
Vinyl toluene.....	100	25
Warfarin.....		1
Xylene (xylol).....	100	5
Xylidine—Skin.....	5	5
Yttrium.....		
Zinc chloride fume.....		
Zinc oxide fume.....		
Zirconium compounds (as Zr).....		

*1970 Addition.

* Parts of vapor or gas per million parts of contaminated air by volume at 25° C. and 760 mm. Hg pressure.

^b Approximate milligrams of particulate per cubic meter of air.

(No footnote "c" is used to avoid confusion with ceiling value notations.)

^c An atmospheric concentration of not more than 0.02 p.p.m., or personal protection may be necessary to avoid headache.^d As sampled by method that does not collect vapor.^e For control of general room air, biologic monitoring is essential for personnel control.

(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.

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 µg./M ³	5 µg./M ³	25 µg./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	0.6 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.	50 p.p.m.	5 minutes.
Ethylene dichloride (Z37.21-1969).....	50 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.			
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.
Organo (alkyl) mercury (Z37.30-1969).....	0.01 mg./M ³	0.04 mg./M ³		
Styrene (Z37.15-1969).....	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 (Z37.8-1971).....		1 mg./10M ³		
Chromic acid and chromates (Z37.7-1971).....		do.		

(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.

TABLE G-3—MINERAL DUSTS

Substance	Mppcf *	Mg/M ³
Silica:		
Crystalline:		
Quartz (respirable).....	250 †	10mg/M ³ =
	%SiO ₂ +6	%SiO ₂ +2
Quartz (total dust).....		30mg/M ³
		%SiO ₂ +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/M ³
		%SiO ₂
Silicates (less than 1% crystalline silica):		
Mica.....	20	
Soapstone.....	20	
Talc (non-asbestos-form)...	20 ^a	
Talc (fibrous). Use asbestos limit		
Tremolite (see talc, fibrous)		
Portland cement.....	50	
Graphite (natural).....	15	
Coal dust (respirable fraction less than 6% SiO ₂).....		2.4mg/M ³
		or
For more than 6% SiO ₂		10mg/M ³
		%SiO ₂ +2
Inert or Nuisance Dust:		
Respirable fraction.....	15	5mg/M ³
Total dust.....	50	15mg/M ³

NOTE: Conversion factors—
mppcf×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 technics.

† 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 430× 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.

(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.

(ii) To illustrate the formula prescribed in subdivision (i) 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.

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)

(i) 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).

(ii) To illustrate the formula prescribed in subdivision (i) 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)	45 p.p.m.	200 p.p.m.
Toluene (Table G-2) ...	40 p.p.m.	200 p.p.m.

Substituting in the formula, we have:

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

$$E_m = 0.500 + 0.225 + 0.200$$

$$E_m = 0.925$$

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.

INDUSTRIAL HYGIENE SURVEY

PLANT LOCATION: _____

DATE: _____

SURVEY EQUIPMENT USED: _____

Sample Number	Description- Location of Test	Sampling Volume	Airborne Contaminant	Concentration*		
				Actual	TLV**	TWA***

*As ppm or mg/m³; **Threshold limit value; ***Time weighted average