

# CONTENTS

Preface

Introduction to the Chemical Substances TLVs®

Introduction to the Documentation of the Chemical Substances TLVs®

Guidelines for Classification of Occupational Carcinogenicity

Chemical Substances TLV® Adopted Appendices

Appendix A: Carcinogenicity

Appendix B: Particles (insoluble or poorly soluble) Not Otherwise Specified [PNOS]

Appendix C: Particle Size-Selective Sampling Criteria for Airborne Particulate Matter

Appendix D: Commercially Important Tree Species Suspected of Inducing Sensitization

Appendix E: Threshold Limit Values for Mixtures

## Documentation: Adopted TLVs®

### A

Acetaldehyde

Acetic acid – 2004 Update

Acetic anhydride

Acetone

Acetone cyanohydrin

Acetonitrile – 2002 Adoption

Acetophenone

Acetylene

Acetylene tetrabromide – Withdrawn 2006; see  
1,1,2,2-Tetrabromoethane

Acetylsalicylic acid

Acrolein

Acrylamide – 2005 Adoption

Acrylic acid

Acrylonitrile

Adipic acid

Adiponitrile

Aldrin

Aliphatic hydrocarbon gases: Alkane [C<sub>1</sub>—C<sub>4</sub>] –  
2004 Adoption

Allyl alcohol

Allyl chloride

Allyl glycidyl ether

Allyl propyl disulfide – 2004 Adoption

Aluminum and compounds

Aluminum oxide

4-Aminodiphenyl

2-Aminopyridine

Amitrole

Ammonia

Ammonium chloride fume

Ammonium perfluorooctanoate

Ammonium sulfamate

tert-Amyl methyl ether – 2002 Adoption

Aniline

Anisidine (o-, p-isomers)

Antimony and compounds

Antimony hydride

Antimony trioxide, Production

ANTU

Argon

Arsenic and inorganic compounds

Arsine

Asbestos, All forms

Asphalt (bitumen), Fumes

Atrazine

Azinphos-methyl – 2002 Adoption

### B

Barium and soluble compounds

Barium sulfate

Benomyl

Benz[a]anthracene

Benzene

Benzidine

Benzo[b]fluoranthene

Benzo[a]pyrene

Benzotrichloride

Benzoyl chloride

Benzoyl peroxide

Benzyl acetate

Benzyl chloride

Beryllium and compounds

Biphenyl

Bis(2-dimethylaminoethyl) ether

Bismuth telluride

Borate compounds, Inorganic – 2005 Adoption

Borates, tetra, sodium salts – Withdrawn 2005

Boron oxide

Boron tribromide

Boron trifluoride

Bromacil

Bromine

Bromine pentafluoride

Bromoform  
1-Bromopropane – 2005 Adoption  
1,3-Butadiene  
Butane, All isomers – Withdrawn 2004; see  
    Aliphatic hydrocarbon gases  
n-Butanol  
n-Butanol – 2002 Adoption  
sec-Butanol – 2002 Update  
tert-Butanol  
2-Butoxyethanol – 2002 Adoption  
2-Butoxyethanol – 2003 Adoption  
2-Butoxyethyl acetate – 2003 Adoption  
n-Butyl acetate  
sec-Butyl acetate  
tert-Butyl acetate  
n-Butyl acrylate – 2003 Update  
n-Butylamine  
Butylated hydroxytoluene  
tert-Butyl chromate  
n-Butyl glycidyl ether – 2005 Adoption  
n-Butyl lactate  
n-Butyl mercaptan  
o-sec-Butylphenol  
p-tert-Butyl toluene

## C

Cadmium and compounds  
Calcium carbonate  
Calcium chromate  
Calcium cyanamide  
Calcium hydroxide  
Calcium oxide  
Calcium silicate, Synthetic nonfibrous  
Calcium sulfate – 2006 Adoption  
Camphor, Synthetic  
Caprolactam – 2003 Adoption  
Captan  
Captan – 2002 Adoption  
Carbaryl  
Carbofuran – 2004 Adoption  
Carbon black  
Carbon dioxide  
Carbon disulfide – 2006 Adoption  
Carbon monoxide  
Carbon tetrabromide  
Carbon tetrachloride  
Carbonyl fluoride  
Catechol  
Cellulose  
Cesium hydroxide  
Chlordane  
Chlorinated camphene  
o-Chlorinated diphenyl oxide  
Chlorine  
Chlorine dioxide  
Chlorine trifluoride

Chloroacetaldehyde  
Chloroacetone  
2-Chloroacetophenone  
Chloroacetyl chloride  
Chlorobenzene  
o-Chlorobenzylidene malononitrile  
Chlorobromomethane  
Chlorodifluoromethane  
Chlorodiphenyl — 42% chlorine  
Chlorodiphenyl — 54% chlorine  
Chloroform  
bis(Chloromethyl) ether  
Chloromethyl methyl ether  
1-Chloro-1-nitropropane  
Chloropentafluoroethane  
Chloropicrin  
 $\beta$ -Chloroprene  
1-Chloro-2-propanol and  
    2-Chloro-1-propanol – 2002 Adoption  
2-Chloropropionic acid  
o-Chlorostyrene  
o-Chlorotoluene  
Chlorpyrifos – 2003 Adoption  
Chromium and inorganic compounds  
Chromyl chloride  
Chrysene  
Clopidol  
Coal dust  
Coal tar pitch volatiles  
Cobalt and inorganic compounds  
Cobalt carbonyl  
Cobalt hydrocarbonyl  
Copper  
Cotton dust, Raw  
Coumaphos – 2006 Adoption  
Cresol, All isomers  
Crotonaldehyde  
Crufomate  
Cumene  
Cyanamide  
Cyanogen  
Cyanogen chloride  
Cyclohexane – 2002 Adoption  
Cyclohexanol  
Cyclohexanone – 2003 Adoption  
Cyclohexene  
Cyclohexylamine  
Cyclonite  
Cyclopentadiene  
Cyclopentane  
Cyhexatin

## D

2,4-D  
DDT  
Decaborane

Demeton – 2002 Adoption  
Demeton-S-methyl – 2002 Adoption  
Diacetone alcohol  
Diazinon – 2003 Adoption  
Diazomethane  
Diborane  
2-N-Dibutylaminoethanol  
Dibutyl phenyl phosphate  
Dibutyl phosphate  
Dibutyl phthalate  
Dichloroacetic acid – 2005 Adoption  
Dichloroacetylene  
o-Dichlorobenzene  
p-Dichlorobenzene  
3,3'-Dichlorobenzidine  
1,4-Dichloro-2-butene  
Dichlorodifluoromethane  
1,3-Dichloro-5,5-dimethyl hydantoin  
1,1-Dichloroethane  
1,2-Dichloroethylene  
Dichloroethyl ether  
Dichlorofluoromethane  
Dichloromethane  
1,1-Dichloro-1-nitroethane  
1,3-Dichloropropene – 2005 Update  
2,2-Dichloropropionic acid  
Dichlorotetrafluoroethane  
Dichlorvos – 2002 Adoption  
Dichrotophos – 2002 Adoption  
Dicyclopentadiene  
Dicyclopentadienyl iron  
Dieldrin  
Diesel fuel – 2002 Adoption  
Diethanolamine  
Diethylamine  
2-Diethylaminoethanol  
Diethylene triamine  
Di(2-ethylhexyl)phthalate  
Diethyl ketone  
Diethyl phthalate  
Difluorodibromomethane  
Diglycidyl ether  
Diisobutyl ketone  
Diisopropylamine  
N,N-Dimethylacetamide  
Dimethylamine  
Dimethylaniline  
Dimethyl carbamoyl chloride  
Dimethylmethoxysilane  
Dimethylformamide  
1,1-Dimethylhydrazine  
Dimethyl phthalate – 2006 Update  
Dimethyl sulfate  
Dimethyl sulfide – 2004 Adoption  
Dinitolmide

Dinitrobenzene, All isomers  
Dinitro-o-cresol  
Dinitrotoluene  
1,4-Dioxane  
Dioxathion – 2002 Adoption  
1,3-Dioxolane – 2002 Adoption  
Diphenylamine  
Dipropyl ketone  
Diquat  
Disulfiram  
Disulfoton – 2002 Adoption  
Diuron  
Divinyl benzene  
Dodecyl mercaptan – 2004 Adoption  
E  
Emery  
Endosulfan  
Endrin  
Enflurane  
Epichlorohydrin  
EPN  
EPN – 2003 Adoption  
Ethane – Withdrawn 2004; see Aliphatic hydro-  
carbon gases  
Ethanol  
Ethanolamine  
Ethion – 2003 Adoption  
2-Ethoxyethanol  
2-Ethoxyethyl acetate  
Ethyl acetate  
Ethyl acrylate  
Ethylamine  
Ethyl amyl ketone  
Ethyl benzene – 2002 Adoption  
Ethyl bromide  
Ethyl tert-butyl ether  
Ethyl butyl ketone  
Ethyl chloride  
Ethyl cyanoacrylate  
Ethylene – 2005 Adoption  
Ethylene chlorohydrin  
Ethylene diamine  
Ethylene dibromide  
Ethylene dichloride  
Ethylene glycol  
Ethylene glycol dinitrate  
Ethylene oxide  
Ethyleneimine  
Ethyl ether  
Ethyl formate  
2-Ethylhexanoic acid – 2002 Adoption  
Ethylene norbornene  
Ethyl mercaptan – 2004 Update  
N-Ethylmorpholine  
Ethyl silicate

## F

Fenamiphos – 2006 Adoption  
Fensulfothion – 2005 Adoption  
Fenthion – 2006 Adoption  
Ferbam  
Ferrovanadium, Dust  
Flour dust  
Fluorides  
Fluorine  
Fonofos – 2006 Adoption  
Formaldehyde  
Formamide  
Formic acid  
Furfural  
Furfuryl alcohol

## G

Gallium arsenide – 2005 Adoption  
Gasoline  
Germanium tetrahydride  
Glutaraldehyde  
Glycerin, Mist  
Glycidol  
Glyoxal  
Grain dust (oat, wheat, and barley)  
Graphite, All forms except graphite fibers

## H

Hafnium and compounds  
Halothane  
Helium  
Heptachlor and Heptachlor epoxide  
Heptane, All isomers  
Hexachlorobenzene  
Hexachlorobutadiene  
Hexachlorocyclopentadiene  
Hexachloroethane  
Hexachloronaphthalene  
Hexafluoroacetone  
Hexahydrophthalic anhydride, All isomers –  
2004 Adoption  
Hexamethylene diisocyanate  
Hexamethyl phosphoramidate  
n-Hexane  
Hexane, Isomers other than n-hexane  
1,6-Hexanediamine  
1-Hexene – 2002 Adoption  
sec-Hexyl acetate  
Hexylene glycol  
Hydrazine  
Hydrogen  
Hydrogenated terphenyls, Nonirradiated  
Hydrogen bromide – 2004 Adoption  
Hydrogen chloride – 2003 Adoption  
Hydrogen cyanide and cyanide salts  
Hydrogen fluoride – 2005 Adoption

Hydrogen peroxide  
Hydrogen selenide  
Hydrogen sulfide  
Hydroquinone  
2-Hydroxypropyl acrylate

## I

Indene  
Indium and compounds  
Iodine  
Iodoform  
Iron oxide – 2006 Adoption  
Iron oxide, Dust and fume – Withdrawn 2006  
Iron pentacarbonyl  
Iron salts, Soluble  
Isoamyl alcohol  
Isobutanol  
Isobutyl acetate  
Isobutyl nitrite – 2003 Adoption  
Isooctyl alcohol  
Isophorone  
Isophorone diisocyanate  
Isopropanol – 2003 Adoption  
2-Isopropoxyethanol  
Isopropyl acetate – 2003 Adoption  
Isopropylamine  
N-Isopropylaniline  
Isopropyl ether  
Isopropyl glycidyl ether

## K

Kaolin  
Kerosene/Jet fuel – 2003 Adoption  
Ketene

## L

Lead and inorganic compounds  
Lead arsenate  
Lead chromate  
Lindane  
Lithium hydride  
Liquefied petroleum gas (LPG) – Withdrawn  
2004; see Aliphatic hydrocarbon gases

## M

Magnesite – Withdrawn 2006  
Magnesium oxide – 2003 Adoption  
Magnesium oxide, Fume – Withdrawn 2003  
Malathion – 2003 Adoption  
Maleic anhydride  
Manganese and inorganic compounds  
Manganese cyclopentadienyl tricarbonyl  
Mercury, All forms except alkyl  
Mercury, Alkyl compounds  
Mesityl oxide  
Methacrylic acid  
Methane – Withdrawn 2004; see Aliphatic

hydrocarbon gases  
Methanol  
Methomyl  
Methoxychlor  
2-Methoxyethanol – 2006 Adoption  
2-Methoxyethyl acetate – 2006 Adoption  
4-Methoxyphenol  
1-Methoxy-2-propanol  
bis-(2-Methoxypropyl) ether  
Methyl acetate  
Methyl acetylene  
Methyl acetylene-propadiene mixture  
Methyl acrylate  
Methylacrylonitrile  
Methylal  
Methylamine  
Methyl n-amyl ketone  
N-Methyl aniline  
Methyl bromide  
Methyl tert-butyl ether – 2002 Adoption  
Methyl n-butyl ketone  
Methyl chloride  
Methyl chloroform  
Methyl 2-cyanoacrylate  
Methyl cyclohexane  
Methylcyclohexanol  
o-Methylcyclohexanone  
2-Methylcyclopentadienyl manganese  
tricarbonyl  
Methyl demeton  
Methylene bisphenyl isocyanate  
4,4'-Methylene bis(2-chloroaniline)  
Methylene bis(4-cyclohexylisocyanate)  
4,4'-Methylene dianiline  
Methyl ethyl ketone  
Methyl ethyl ketone peroxide  
Methyl formate  
Methyl hydrazine  
Methyl iodide  
Methyl isoamyl ketone  
Methyl isobutyl carbinol  
Methyl isobutyl ketone  
Methyl isocyanate  
Methyl isopropyl ketone  
Methyl mercaptan – 2004 Update  
Methyl methacrylate  
Methyl parathion  
Methyl propyl ketone  
Methyl silicate  
 $\alpha$ -Methyl styrene  
Methyl vinyl ketone  
Metribuzin  
Mevinphos – 2003 Adoption  
Mica  
Molybdenum and compounds

Molybdenum and compounds – 2003 Adoption  
Monochloroacetic acid – 2006 Adoption  
Monocrotophos – 2002 Adoption  
Morpholine  
N  
Naled  
Naled – 2002 Adoption  
Naphthalene  
 $\beta$ -Naphthylamine  
Natural rubber latex – 2004 Adoption  
Neon  
Nickel and inorganic compounds  
Nickel carbonyl  
Nickel subsulfide  
Nicotine  
Nitrapyrin  
Nitric acid  
Nitric oxide  
p-Nitroaniline  
Nitrobenzene  
p-Nitrochlorobenzene  
4-Nitrodiphenyl  
Nitroethane  
Nitrogen  
Nitrogen dioxide  
Nitrogen trifluoride  
Nitroglycerin  
Nitromethane  
1-Nitropropane  
2-Nitropropane  
N-Nitrosodimethylamine  
Nitrotoluene, All isomers  
Nitrous oxide  
Nonane, All isomers  
O  
Octachloronaphthalene  
Octane, All isomers  
Oil mist, Mineral  
Osmium tetroxide  
Oxalic acid  
p,p'-Oxybis(benzenesulfonyl hydrazide)  
Oxygen difluoride  
Ozone  
P  
Paraffin wax fume  
Paraquat  
Parathion – 2003 Adoption  
Particulates (Insoluble) Not Otherwise  
Specified – Withdrawn 2003  
Pentaborane  
Pentachloronaphthalene  
Pentachloronitrobenzene  
Pentachlorophenol  
Pentaerythritol

Pentane, All isomers  
Pentyl acetate, All isomers  
Perchloromethyl mercaptan  
Perchloryl fluoride  
Perfluorobutyl ethylene – 2004 Adoption  
Perfluoroisobutyene  
Perlite – Withdrawn 2006  
Persulfates  
Phenol  
Phenothiazine  
N-Phenyl- $\beta$ -naphthylamine  
o-Phenylenediamine  
m-Phenylenediamine  
p-Phenylenediamine  
Phenyl ether  
Phenyl glycidyl ether – 2002 Update  
Phenylhydrazine  
Phenyl mercaptan – 2004 Adoption  
Phenylphosphine  
Phorate – 2005 Adoption  
Phosgene  
Phosphine  
Phosphoric acid  
Phosphorus (yellow)  
Phosphorus oxychloride  
Phosphorus pentachloride  
Phosphorus pentasulfide  
Phosphorus trichloride  
Phthalic anhydride  
m-Phthalodinitrile  
Picloram  
Picric acid  
Pindone  
Piperazine dihydrochloride  
Platinum and soluble salts  
Polytetrafluoroethylene decomposition  
products – Withdrawn 2004  
Portland cement  
Potassium hydroxide  
Propane – Withdrawn 2004; see Aliphatic  
hydrocarbon gases  
Propane sulfone  
n-Propanol  
n-Propanol – 2004 Adoption  
Propargyl alcohol  
Propionaldehyde – 2002 Adoption  
 $\beta$ -Propiolactone  
Propionic acid  
Propoxur  
n-Propyl acetate  
Propylene – 2006 Adoption  
Propylene dichloride – 2006 Adoption  
Propylene glycol dinitrate  
Propylenimine  
Propylene oxide

n-Propyl nitrate  
Pyrethrum  
Pyridine  
Pyridine – 2004 Adoption  
**Q**  
Quinone  
**R**  
Resorcinol  
Rhodium and compounds  
Ronnel – 2006 Adoption  
Rosin core solder thermal decomposition  
products  
Rotenone (commercial)  
Rouge – Withdrawn 2006; see Iron oxide  
Rubber solvent  
**S**  
Selenium and compounds  
Selenium hexafluoride  
Sesone  
Silica, Amorphous — Diatomaceous earth –  
Withdrawn 2006  
Silica, Amorphous — Fume – Withdrawn 2006  
Silica, Amorphous — Fused – Withdrawn  
2006  
Silica, Amorphous — Precipitated silica and  
silica gel – Withdrawn 2006  
Silica, Crystalline —  $\alpha$ -Quartz and Cristobalite –  
2006 Adoption  
Silica, Crystalline — Cristobalite – Withdrawn  
2006  
Silica, Crystalline — Quartz – Withdrawn 2006  
Silica, Crystalline — Tridymite – Withdrawn  
2005  
Silica, Crystalline — Tripoli – Withdrawn 2006  
Silicon – Withdrawn 2006  
Silicon carbide – 2004 Adoption  
Silicon tetrahydride  
Silver and compounds  
Soapstone  
Sodium azide  
Sodium bisulfite  
Sodium fluoroacetate  
Sodium hydroxide  
Sodium metabisulfite  
Starch  
Stearates  
Stoddard solvent  
Strontium chromate  
Strychnine  
Styrene, monomer  
Subtilisins  
Sucrose  
Sulfometuron methyl  
Sulfotep – Withdrawn 2005

Sulfotepp – 2005 Adoption  
Sulfur dioxide  
Sulfur hexafluoride  
Sulfuric acid  
Sulfuric acid – 2004 Adoption  
Sulfur monochloride  
Sulfur pentafluoride  
Sulfur tetrafluoride  
Sulfuryl fluoride  
Sulprofos  
Synthetic Vitreous Fibers  
T  
2,4,5-T  
Talc  
Tantalum and tantalum oxide  
Tellurium and compounds  
Tellurium hexafluoride  
Temephos – 2005 Adoption  
Terbufos – 2002 Adoption  
Terephthalic acid  
Terphenyls  
1,1,2,2-Tetrabromoethane – 2006 Adoption  
1,1,1,2-Tetrachloro-2,2-difluoroethane  
1,1,2,2-Tetrachloro-1,2-difluoroethane  
1,1,2,2-Tetrachloroethane  
Tetrachloroethylene  
Tetrachloronaphthalene  
Tetraethyl lead  
Tetraethyl pyrophosphate [TEPP]  
Tetrafluoroethylene  
Tetrahydrofuran – 2005 Adoption  
Tetrakis (hydroxymethyl) phosphonium salts –  
2005 Adoption  
Tetramethyl lead  
Tetramethyl succinonitrile  
Tetranitromethane  
Tetrasodium pyrophosphate – Withdrawn 2006  
Tetryl  
Thallium and soluble compounds  
4,4'-Thiobis(6-tert-butyl-m-cresol)  
Thioglycolic acid  
Thionyl chloride  
Thiram  
Tin and Inorganic compounds, excluding  
tin hydride  
Tin, Organic compounds  
Titanium dioxide  
o-Tolidine  
Toluene  
Toluene-2,4-diisocyanate – Withdrawn 2004  
Toluene-2,4 or 2,6-diisocyanate (or as a  
mixture) – 2004 Adoption  
o-Toluidine  
m-Toluidine  
p-Toluidine

Tributyl phosphate  
Trichloroacetic acid  
1,2,4-Trichlorobenzene  
1,1,2-Trichloroethane  
Trichloroethylene  
Trichlorofluoromethane  
Trichloronaphthalene  
1,2,3-Trichloropropane  
1,1,2-Trichloro-1,2,2-trifluoroethane  
Trichlorphon – 2003 Adoption  
Triethanolamine  
Triethylamine  
Trifluorobromomethane  
1,3,5-Triglycidyl-s-triazinetrione  
Trimellitic anhydride  
Trimethylamine  
Trimethyl benzene, Isomers  
Trimethyl phosphite  
2,4,6-Trinitrotoluene  
Triorthocresyl phosphate  
Triphenyl amine  
Triphenyl phosphate  
Tungsten and compounds  
Turpentine – Withdrawn 2003  
Turpentine and selected monoterpenes – 2003  
Adoption

## U

Uranium (natural) and compounds

## V

n-Valeraldehyde  
Vanadium pentoxide  
Vegetable oil, Mists – Withdrawn 2006  
Vinyl acetate  
Vinyl bromide  
Vinyl chloride  
4-Vinyl cyclohexene  
Vinyl cyclohexene dioxide  
Vinyl fluoride  
N-Vinyl-2-pyrrolidone – 2003 Adoption  
Vinylidene chloride  
Vinylidene fluoride  
Vinyl toluene  
VM & P Naphtha

## W

Warfarin  
Welding fumes (not otherwise specified) –  
Withdrawn 2004  
Wood dust – Withdrawn 2005  
Wood dusts – 2005 Adoption

## X

Xylene, All isomers  
m-Xylene  $\alpha,\alpha'$ -diamine  
Xylidine, Mixed isomers

Xylidine, Mixed isomers – 2002 Adoption

**Y**

Yttrium and compounds

**Z**

Zinc chloride, Fume

Zinc chromates

Zinc oxide

Zirconium and compounds