

VIII. APPENDIX B

SUMMARY OF HEALTH EFFECTS AND EXPOSURE LIMITS FOR SUBSTANCES POTENTIALLY PRESENT  
IN THE MANUFACTURE OF PAINT AND ALLIED COATING PRODUCTS

Agent	Occupational Exposure Limit*		Health Effects
	OSHA**	NIOSH Recommended***	
<b><u>Pigments and Extenders</u></b>			
Antimony and compounds (as Sb)	0.5 mg/m <sup>3</sup> TWA	0.5 mg/m <sup>3</sup> TWA	Irritation of the skin and mucous membranes, cardiac and respiratory changes [72]
Asbestos	2 fibers/cm <sup>3</sup> TWA; 10 fibers/cm <sup>3</sup> ceiling	0.1 fibers/cm <sup>3</sup> TWA (8-hr), 0.5 fibers/cm <sup>3</sup> ceiling	Asbestosis, lung cancer, <b>mesothelioma</b> [73]
Barium (soluble compounds)	0.5 mg/m <sup>3</sup> TWA	§	Irritation of the eyes, nose, throat, bronchial tubes, and skin; stomach pains; slow pulse rate; irregular heart beat; ringing in the ears; dizziness; convulsions; muscle spasms [74]
Cadmium	Fume: 0.1 mg/m <sup>3</sup> TWA, 0.3 mg/m <sup>3</sup> ceiling Dust: 0.2 mg/m <sup>3</sup> TWA, 0.6 mg/m <sup>3</sup> ceiling	40 µg/m <sup>3</sup> TWA, 200 µg/m <sup>3</sup> ceiling	Lung and kidney damage, emphysema [75]
Carbon black	3.5 mg/m <sup>3</sup> TWA	3.5 mg/m <sup>3</sup> TWA, 0.1 mg/m <sup>3</sup> TWA in presence of polycyclic aromatic hydrocarbons	Lung, heart, and skin effects; <b>cancer</b> [76]
Chromium compounds: chromium (VI)	100 µg/m <sup>3</sup> ceiling	<b>carcinogenic Cr (VI):</b> 1 µg/m <sup>3</sup> TWA <b>other Cr (VI):</b> 25 µg/m <sup>3</sup> TWA, 50 µg/m <sup>3</sup> ceiling	<b>Lung cancer</b> , skin ulcers, lung irritation [77]
metal and insoluble salts (as Cr)	1 mg/m <sup>3</sup> TWA	§	Lung changes [74]
soluble chromic, chromous salts (as Cr)	0.5 mg/m <sup>3</sup> TWA	§	Dermatitis [74]

Cobalt, metal, fume, and dust (as Co)	0.1 mg/m <sup>3</sup> TWA	NIOSH has concluded that there is insufficient evidence to warrant recommending a new permissible exposure limit	Dermatitis, potential for pulmonary fibrosis [78]
Copper, dust and mists (as Cu)	1 mg/m <sup>3</sup> TWA	§	Irritation of the eyes and skin, flu-like illness [74]
Inert or nuisance dust	15 mg/m <sup>3</sup> TWA (total dust), 5 mg/m <sup>3</sup> TWA (respirable fraction)	§	Irritation, slight lung changes [74]
Iron oxide fume	10 mg/m <sup>3</sup> TWA	§	Benign pneumoconiosis (siderosis) [74]
Lead, inorganic fumes and dusts (as Pb)	50 µg/m <sup>3</sup> TWA	100 µg/m <sup>3</sup> TWA	Kidney, blood, and nervous system effects [79]
Manganese and compounds (as Mn)	5 mg/m <sup>3</sup> (ceiling)	§	Flu-like illness called metal fume fever: fever, chills, upset stomach, vomiting, dryness of the throat, cough, weakness, headache; manganese pneumonia: coughing, fever, chills, general aching of the body, chest pains; nervous system effects [74]
<b>Mercury:</b>			
inorganic (as Hg)	0.1 mg/m <sup>3</sup> ceiling	0.05 mg/m <sup>3</sup> TWA	Central nervous system and mental effects [80]
organo (alkyl) compounds (as Hg)	10 µg/m <sup>3</sup> TWA, 40 µg/m <sup>3</sup> ceiling	§	Irritation of the eyes, respiratory tract, and skin; dysfunction of the central nervous system [74]
Nickel, metal and soluble compounds (as Ni)	1 mg/m <sup>3</sup> TWA	15 µg/m <sup>3</sup> TWA	Skin effects, lung and nasal cancer [81]
Silica, crystalline	250/% SiO <sub>2</sub> +5 in mppcf TWA or 10/% SiO <sub>2</sub> +2 in mg/m <sup>3</sup> TWA (respirable quartz); 30/% SiO <sub>2</sub> +2 in mg/m <sup>3</sup> TWA (total quartz dust)	50 µg/m <sup>3</sup> TWA (respirable free silica)	Chronic lung disease (silicosis): scarring of lungs, cough, and shortness of breath [82]

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	OSHA**	NIOSH Recommended***	
<b>Talc:</b>			
non-asbestos form	20 mppcf TWA	§	Irritation of the eyes, shortness of breath, chronic cough, heart failure [74]
fibrous	see Asbestos	§	See Asbestos
Titanium dioxide	15 mg/m <sup>3</sup> TWA	§	Irritation, slight lung changes [74]
Zinc oxide fume	5 mg/m <sup>3</sup> TWA	5 mg/m <sup>3</sup> TWA, 15 mg/m <sup>3</sup> ceiling	Flu-like illness called metal fume fever: headache, fever, chills, muscle aches, nausea, vomiting, weakness, and tiredness [83]
<b><u>Solvents</u></b>			
<b>Alcohols:</b>			
2-butoxy ethanol (butyl Cellosolve®)	50 ppm TWA (skin)	§	Irritation of the eyes, nose, and throat [74]
butyl alcohol	100 ppm TWA	§	Irritation of the eyes, nose, and throat; headache; dizziness; drowsiness; blurred vision [74]
diacetone alcohol (4-hydroxy-4-methyl- 2-pentanone)	50 ppm TWA	50 ppm TWA	Irritation of the eyes, nose, throat, and skin; liver, kidney, and central nervous system effects [84]
ethyl alcohol (ethanol)	1,000 ppm TWA	§	Irritation of the eyes, nose upper respiratory tract, and skin; headache; drowsiness; tremors; fatigue [85]
furfuryl alcohol	50 ppm TWA	50 ppm TWA	Irritation of the eyes, skin, and upper respiratory system; depression of the central nervous system [86]

isobutyl alcohol	100 ppm TWA	§	Irritation of the eyes, nose, and throat; headache; dizziness; drowsiness; drying and cracking of skin [74]
isopropyl alcohol	400 ppm TWA	400 ppm TWA, 800 ppm ceiling	Irritation of the eyes, nose, and throat; drowsiness; headache, incoordination; possible <b>cancer</b> threat in the manufacturing of isopropyl alcohol [87]
methyl alcohol (methanol)	200 ppm TWA	200 ppm TWA, 800 ppm ceiling	Irritation of the eyes and skin, headache, dizziness, sleep problems, digestive disturbances, blindness, metabolic acidosis [88]
propyl alcohol	200 ppm TWA	§	Irritation of the eyes, nose, and throat; drowsiness; headache; incoordination [74]
Aliphatic hydrocarbons: cyclohexane	300 ppm TWA	§	Skin rash, dizziness, nausea [74]
heptane (n-heptane)	500 ppm TWA	85 ppm TWA, 400 ppm ceiling	Irritation of the eyes, nose, and throat; light-headedness; dizziness; nausea; loss of appetite [89]
hexane (n-hexane)	500 ppm TWA	100 ppm TWA, 510 ppm ceiling	Irritation of the eyes, nose, and skin; light-headedness; giddiness; nausea; headache [89]
methylcyclohexane	500 ppm TWA	§	Irritation of the eyes, nose, throat, and skin; light-headedness; drowsiness; unconsciousness [74]
octane	500 ppm TWA	75 ppm TWA, 385 ppm ceiling	Irritation of the eyes, nose, and skin; drowsiness; unconsciousness [89]
pentane	1,000 ppm TWA	120 ppm TWA, 610 ppm ceiling	Irritation of the eyes, nose, and skin; drowsiness; unconsciousness [89]

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	OSHA**	NIOSH Recommended***	
Aromatic hydrocarbons:			
ethyl benzene	100 ppm TWA	§	Irritation of the eyes, nose, throat, and skin; weakness; dizziness; drowsiness; unconsciousness [74]
naphthalene	10 ppm TWA	§	Irritation of the eyes and skin, abdominal cramps, nausea, vomiting, diarrhea, headache, tiredness, confusion, painful urination, anemia, fever, kidney and liver damage [74]
toluene	200 ppm TWA, 300 ppm acceptable ceiling, 500 ppm maximum peak (10 minutes during 8 hours)	100 ppm TWA (8-hour), 200 ppm ceiling (10 minutes)	Irritation of the eyes, respiratory tract, and skin; fatigue; headache; weakness; confusion; dizziness; drowsiness; numbness; unconsciousness [90]
xylene (xylol)	100 ppm TWA	100 ppm TWA, 200 ppm ceiling (10 minutes)	Irritation of the eyes, nose, throat, and skin; breathing difficulties; dizziness; staggering; drowsiness; unconsciousness; loss of appetite; nausea; vomiting; abdominal pain; reversible eye damage [91]
Chlorinated hydrocarbons:			
methylene chloride	500 ppm TWA, 1,000 ppm acceptable ceiling, 2,000 ppm maximum peak (5 minutes in any 2 hours)	75 ppm TWA, 500 ppm ceiling to be lowered in presence of carbon monoxide	Irritation of the eyes, respiratory tract, and skin; mental confusion; light-headedness; nausea; vomiting; headache; staggering; unconsciousness; carbon monoxide toxicity [92]

tetrachloroethylene (perchloroethylene)	100 ppm TWA, 200 ppm acceptable ceiling, 600 ppm maximum peak (5 minutes in any 3 hours)	50 ppm TWA, 100 ppm ceiling (twice daily)	Nervous system, heart, respiratory, and liver effects [93]
trichloroethylene	100 ppm TWA, 200 ppm acceptable ceiling, 300 ppm maximum peak (5 minutes in any 2 hours)	100 ppm TWA, 150 ppm ceiling (10 minutes)	Central nervous system depressant, cancer [94,95]
Dioxane (diethylene dioxide)	100 ppm TWA (skin)	1 ppm ceiling (30 minutes)	Irritation of the eyes, nose, throat, and skin; drowsiness; dizziness; loss of appetite; headache; nausea; vomiting; stomach pain; liver and kidney damage; <b>potential human carcinogen</b> [96]
<b>Esters:</b>			
butyl acetate (n-butyl acetate)	150 ppm TWA	§	Irritation of the eyes, nose, throat, and skin; weakness; drowsiness; unconsciousness [74]
sec-butyl acetate	200 ppm TWA	§	Irritation of the eyes, nose, throat, and skin; weakness; drowsiness; unconsciousness [74]
2-ethoxyethyl acetate (Cellosolve® acetate)	100 ppm TWA (skin)	§	Irritation of the eyes and nose, vomiting, kidney damage, paralysis [74]
ethyl acetate	400 ppm TWA	§	Irritation of the eyes, nose, throat, and skin; weakness; drowsiness; unconsciousness [74]
isobutyl acetate	100 ppm TWA	§	Irritation of the eyes, nose, throat, and skin; weakness; drowsiness; unconsciousness [74]
isopropyl acetate	250 ppm TWA	§	Irritation of the eyes, nose, throat, and skin; weakness; drowsiness; unconsciousness [74]

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methyl acetate	200 ppm TWA	§	Irritation of the eyes, nose, throat, and skin; headache; drowsiness; unconsciousness; vision disturbances [74]
methyl Cellosolve® acetate (ethylene glycol monomethyl ether acetate)	25 ppm TWA (skin)	§	Irritation of the eyes, respiratory tract and skin; possible kidney damage [74]
n-propyl acetate	200 ppm TWA	§	Irritation of the eyes, nose, throat, and skin; weakness; drowsiness; unconsciousness [74]
<b>Furans:</b>			
tetrahydrofuran	200 ppm TWA	§	Irritation of the eyes and nose, drying of the skin, nausea, dizziness, headache [74]
furfural	5 ppm TWA (skin)	§	Irritation of the eyes, respiratory tract, and skin; unconsciousness; sensitization of the skin; loss of sense of taste; numbness of the tongue [74]
<b>Glycols:</b>			
2-ethoxy ethanol (Cellosolve®)	200 ppm TWA (skin)	Appropriate controls should be instituted to minimize worker exposure	Irritation of the eyes and skin. In animals: liver, kidney, and lung damage; anemia; adverse reproductive effects [97]

methyl Cellosolve® (2-methoxy ethanol)	25 ppm TWA (skin)	Appropriate controls should be instituted to minimize worker exposure	Irritation of the eyes, nose, and throat; drowsiness; weakness; shaking; headache; fatigue; staggering; personality change; anemia; adverse reproductive effects [97]
methyl Cellosolve® acetate (ethylene glycol monomethyl ether acetate)	25 ppm TWA (skin)	§	Irritation of the eyes, res- piratory tract, and skin; possible kidney damage [74]
Hydrocarbon mixtures: naphtha (coal tar)	400 mg/m <sup>3</sup> TWA	§	Irritation of the eyes, nose, and skin; light-headedness; drowsiness; unconsciousness [74]
mineral spirits	§§	350 mg/m <sup>3</sup> TWA, 1,800 mg/m <sup>3</sup> ceiling	Irritation of the eyes, nose, throat, and skin; dizziness [56]
petroleum distillates (naphtha)	2,000 mg/m <sup>3</sup> TWA	350 mg/m <sup>3</sup> TWA, 1,800 mg/m <sup>3</sup> ceiling	Irritation of the eyes, throat, and skin; dizziness; drowsiness; headache; nausea [56]
stoddard solvent	2,900 mg/m <sup>3</sup> TWA	350 mg/m <sup>3</sup> TWA, 1,800 mg/m <sup>3</sup> ceiling	Irritation of the eyes, nose, throat, and skin; dizziness; unconsciousness [56]
Ketones: acetone	1,000 ppm TWA	250 ppm TWA	Irritation of the eyes, nose, throat, and skin; upset stomach; vomiting; headache; sleepiness; dizziness; weakness; incoordination; unconsciousness; liver and kidney effects [84]
2-butanone (methyl ethyl ketone)	200 ppm TWA	200 ppm TWA	Irritation of the eyes, nose, throat, and skin; headache; dizziness; upset stomach; vomiting; unconsciousness; liver and kidney effects [84]
cyclohexanone	50 ppm TWA	25 ppm TWA	Irritation of the eyes, nose, and throat; skin rash; dizziness; unconsciousness; liver and kidney effects [84]

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	OSHA**	NIOSH Recommended***	
diacetone alcohol (4-hydroxy-4-methyl- 2-pentanone)	50 ppm TWA	50 ppm TWA	Irritation of the eyes, nose, throat, and skin; central nervous system, liver and kidney effects [84]
diisobutyl ketone	50 ppm TWA	25 ppm TWA	Irritation of the eyes, nose, throat, and skin; headache; dizziness; drowsiness; unconsciousness; liver and kidney effects [84]
ethyl sec-amyl ketone (5-methyl-3-heptanone)	25 ppm TWA	§	Irritation of the eyes, nose, throat, and skin; headache; dizziness; unconsciousness [74]
2-hexanone (methyl butyl ketone)	100 ppm TWA	1 ppm TWA	Irritation of the eyes, nose, throat, and skin; headache; drowsiness; unconsciousness; liver and kidney effects; peripheral neuropathy: weakness, numbness, and tingling of the arms and legs [84]
hexone (methyl isobutyl ketone)	100 ppm TWA	50 ppm TWA	Irritation of the eyes, nose, throat, respiratory tract, and skin; nausea; headache; dizziness; unconsciousness; liver and kidney effects; [84]
isophorone	25 ppm TWA	4 ppm TWA	Irritation of the eyes, nose, throat, and skin; headache; dizziness; faintness; fatigue; malaise; liver and kidney effects [84]

mesityl oxide	25 ppm TWA	10 ppm TWA	Irritation of the eyes, nose, throat, and skin; dizziness; headache; unconsciousness; damage to liver, kidney, and lungs [84]
methyl (n-amyl) ketone (2-heptanone)	100 ppm TWA	100 ppm TWA	Irritation of the eyes, nose, throat, and skin; headache; dizziness; unconsciousness; liver and kidney effects [84]
2-pentanone (methyl propyl ketone)	200 ppm TWA	150 ppm TWA	Irritation of the eyes, nose, throat, and skin; drowsiness; unconsciousness; liver and kidney effects [84]
Nitroparaffins: 2-nitropropane	25 ppm TWA	Handle in the workplace as if it were a human carcinogen	Potential human carcinogen, liver damage, nausea, vomiting, diarrhea, anorexia, headache, dizziness [84]
Quinones: quinone (p-benzoquinone)	0.1 ppm TWA	§	Irritation of the eyes, nose, and throat; skin irritation and ulceration; permanent vision difficulties [74]
Terpenes: turpentine	100 ppm TWA	§	Irritation of the eyes, nose, throat, lungs, and skin; headache; dizziness; painful urination; unconsciousness; skin sensitization [74]
<b><u>Film-Forming Components</u></b>			
Acetonitrile	40 ppm TWA	§	Irritation of the nose and throat, chest tightness, nausea, vomiting, respiratory depression, weakness, convulsions, shock, unconsciousness [74]
Acrylates: ethyl acrylate	25 ppm TWA (skin)	§	Irritation of the eyes, nose, throat, lungs, and skin; lung damage [74]
methyl acrylate	10 ppm TWA (skin)	§	Irritation of the eyes, nose, throat, lungs, and skin; lung damage [74]

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	OSHA**	NIOSH Recommended***	
methyl methacrylate	100 ppm TWA	§	Irritation of the eyes, nose, throat, and skin; drowsiness; unconsciousness [74]
Acrylonitrile (AN)	2 ppm TWA, 10 ppm ceiling (15 minutes) No skin or eye contact with liquid AN	Handle in the workplace as if it were a <b>human carcinogen</b>	<b>Potential lung and colon carcinogen</b> ; damage to the central nervous system, lungs, liver, and kidneys [99,100]
Diisocyanates	toluene-2,4-diisocyanate (TDI) 0.14 mg/m <sup>3</sup> ceiling; methylene bisphenyl isocyanate (MDI) 0.2mg/m <sup>3</sup> ceiling	toluene-2,4-diisocyanate (TDI) 35 µg/m <sup>3</sup> TWA, 140 µg/m <sup>3</sup> ceiling (10 minutes); methylene bisphenyl isocyanate (MDI) 50 µg/m <sup>3</sup> TWA, 200 µg/m <sup>3</sup> ceiling (10 minutes); hexamethylene diisocyanate (HDI) 35 µg/m <sup>3</sup> TWA, 140 µg/m <sup>3</sup> ceiling (10 minutes)	Irritation of the eyes and skin, bronchitis, chest tightness, labored breathing, pulmonary edema, possible sensitization [101,102]
Epichlorohydrin	5 ppm TWA (skin)	Treat in the workplace as if it were a <b>human carcinogen</b> , minimize occupational exposure	Irritation of the eyes, respiratory tract, and skin; coughing; chest congestion; running nose; headache; nausea; vomiting; difficulty breathing; possible sensitization; <b>potential human carcinogen</b> [103,104]
Formaldehyde	3 ppm TWA, 5 ppm acceptable ceiling, 10 ppm maximum peak (30 minutes)	Reduce occupational exposure to lowest feasible limit	Irritation of the eyes and upper respiratory tract, coughing, chest tightness, palpitation of the heart, pulmonary edema, inflammation of the lungs, dermatitis, <b>potential human carcinogen</b> [105,106]

Glycidyl Ethers	allyl glycidyl ether 10 ppm ceiling; isopropyl glycidyl ether 50 ppm TWA; phenyl glycidyl ether 10 ppm TWA; n-butyl glycidyl ether 50 ppm TWA	allyl glycidyl ether 9.6 ppm ceiling; isopropyl glycidyl ether 50 ppm ceiling, phenyl glycidyl ether 1 ppm ceiling; n-butyl glycidyl ether 4.4 ppm ceiling	Irritation of the skin and mucous membranes, potential sensitizer [107]
Styrene	100 ppm TWA, 200 ppm acceptable ceiling, 600 ppm maximum peak (5 minutes in any 3 hours)	50 ppm TWA, 100 ppm ceiling	Irritation of the eyes, nose, throat, and skin; central nervous system depression: headache, fatigue, dizziness, nausea, poor memory, and drowsiness [108]
Vinyl Chloride	1 ppm TWA, 5 ppm ceiling (15 minutes)	Minimum detectable level	Liver cancer [109]
<b><u>Additives</u></b>			
Arsenic (inorganic compounds (as As))	10 $\mu\text{g}/\text{m}^3$ TWA	2 $\mu\text{g}/\text{m}^3$ ceiling	Dermatitis, lung and lymphatic cancer [110]
Molybdenum: soluble compounds	5 $\text{mg}/\text{m}^3$ TWA	§	Irritation of the eyes, nose, and throat; loss of appetite; incoordination [74]
insoluble compounds	15 $\text{mg}/\text{m}^3$ TWA	§	Irritation of the eyes, nose, and throat [74]
Pentachlorophenol	0.5 $\text{mg}/\text{m}^3$ TWA (skin)	§	Irritation of the eyes and respiratory tract, bronchitis, weakness, loss of appetite, nausea, vomiting, shortness of breath, chest pain, excessive sweating, headache, dizziness, acne-like skin rash, liver damage [74]
Silver, metal and soluble compounds	0.01 $\text{mg}/\text{m}^3$ TWA	§	Irritation of the eyes and skin [74]
Tin (organic compounds as Sn)	0.1 $\text{mg}/\text{m}^3$ TWA	0.1 $\text{mg}/\text{m}^3$ TWA	Irritation and burns of the skin, eye irritation, headache, vomiting, damage to the nervous system, liver effects [111]

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	OSHA**	NIOSH Recommended***	
Tributyl phosphate	5 mg/m <sup>3</sup> TWA	§	Irritation of the eyes, nose, and throat; nausea, headache [185]
Trimellitic anhydride	§§	Exposure should be limited to as few employees as possible, while minimizing exposure levels	Irritation of the eyes, nose respiratory tract, and skin; pulmonary edema; sensitization [112]
Triorthocresyl phosphate	0.1 mg/m <sup>3</sup> TWA	§	Paralysis of the lower arms and legs, nausea, vomiting, diarrhea, abdominal pain [74]
Zinc oxide fume	5 mg/m <sup>3</sup> TWA	5 mg/m <sup>3</sup> TWA, 15 mg/m <sup>3</sup> ceiling	Flu-like illness called metal fume fever: headache, fever, chills, muscle aches, nausea, vomiting, weakness, and tiredness [83]
Zirconium compounds (as Zr)	5 mg/m <sup>3</sup> TWA	§	Skin rash [74]
<u>Other Materials</u>			
Acetic acid	10 ppm TWA	§	Irritation of the eyes, nose, throat, lungs, and skin; possible corrosive effects upon direct contact with liquid [74]
Acrolein	0.1 ppm TWA	§	Irritation of the eyes, nose, throat, and skin; pressure in chest; headache; dizziness; upset stomach [74]
Amines:			
ethanolamine	3 ppm TWA	§	Irritation of the eyes, nose, and skin [74]
triethylamine	25 ppm TWA	§	Irritation of the eyes, nose, throat, and skin [74]

Ammonia	50 ppm TWA	50 ppm ceiling (5 minutes)	Irritation of the eyes, skin, and respiratory system; coughing; chest pain; breathing difficulties [113]
Benzene	10 ppm TWA, 25 ppm acceptable ceiling, 50 ppm maximum peak (10 minutes during 8 hours)	1 ppm ceiling (2 hours)	Blood changes including <b>leukemia</b> , skin irritation central nervous system depression [114,115]
Benzoyl peroxide	5 mg/m <sup>3</sup> TWA	5 mg/m <sup>3</sup> TWA	Irritation of the eyes and respiratory tract, skin effects [116]
Beryllium	2 µg/m <sup>3</sup> TWA, 5 µg/m <sup>3</sup> acceptable ceiling, 25 µg/m <sup>3</sup> maximum peak (30 minutes during 8 hours)	Not to exceed 0.5 µg/m <sup>3</sup>	<b>Lung cancer</b> [117]
Camphor	2 mg/m <sup>3</sup> TWA	§	Irritation of the eyes, sore throat, nausea, vomiting, headache, dizziness, confusion, irrational behavior, convulsions, kidney effects [74]
Carbon monoxide	50 ppm TWA	35 ppm TWA, 200 ppm ceiling (no minimum time)	Headache, nausea, dizziness, weakness, rapid breathing, unconsciousness, heart effects [118]
Carbon tetrachloride	10 ppm TWA, 25 ppm acceptable ceiling, 200 ppm maximum peak (5 minutes in any 4 hours)	2 ppm ceiling (60 minutes)	<b>Liver cancer</b> [119]
Chromic acid and chromates (as CrO <sub>3</sub> )	100 µg/m <sup>3</sup> ceiling	50 µg/m <sup>3</sup> TWA, 100 µg/m <sup>3</sup> ceiling	Nasal ulceration [120]
Coal tar pitch volatiles (benzene-soluble fraction)	0.2 mg/m <sup>3</sup> TWA	0.1 mg/m <sup>3</sup> TWA (cyclohexane-extractable fraction)	<b>Lung and skin cancer</b> [121]
Copper fume (as Cu)	0.1 mg/m <sup>3</sup> TWA	§	Irritation of the eyes, nose, and throat; flu-like illness called metal fume fever: fever, muscle aches, nausea, chills, dry throat, cough, and weakness [74]

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	OSHA**	NIOSH Recommended***	
Dimethylaniline	5 ppm TWA (skin)	§	Drowsiness, headache, nausea, vomiting [74]
Hydrogen chloride	5 ppm TWA	§	Irritation of the eyes, respiratory tract, and skin; erosion of the teeth [74]
Maleic anhydride	0.25 ppm TWA	§	Irritation of the eyes, nose, throat, and skin; coughing; sneezing; double vision [74]
Methyl chloroform	350 ppm TWA	350 ppm ceiling	Nervous system, liver, and heart effects [122]
Nitrogen dioxide	5 ppm ceiling	1 ppm ceiling	Respiratory and blood effects [123]
Phthalic anhydride	2 ppm TWA	§	Irritation of the eyes, nose, throat, and skin; coughing; sneezing; nosebleeds [74]
Pyridine	5 ppm TWA	§	Irritation of the eyes, respiratory tract, and skin; diarrhea; abdominal pain; nausea; weakness; headache; dizziness; nervousness; damage to the central nervous system, liver, and kidneys [74]
Sodium hydroxide	2 mg/m <sup>3</sup> TWA	2 mg/m <sup>3</sup> ceiling	Irritation and corrosive damage to the eyes, respiratory tract, and skin [124]

Sulfuric acid	1 mg/m <sup>3</sup> TWA	1 mg/m <sup>3</sup> TWA	Irritation of the eyes, nose, throat, and skin; erosion of the teeth [125]
Zinc chloride fume	1 mg/m <sup>3</sup> TWA	§	Shortness of breath, a feeling of constriction in chest, abdominal pain, watering of the eyes, burning of the eyes and throat, coughing with phlegm and bloody sputum, pneumonia [74]

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\*TWA: time-weighted average; mg/m<sup>3</sup>: milligrams of particulate per cubic meter of air; µg/m<sup>3</sup>: micrograms of particulate per cubic meter of air; ppm: parts of vapor or gas per million parts of contaminated air; mppcf: millions of particles per cubic foot of air; SiO<sub>2</sub>: crystalline silica; fibers/cm<sup>3</sup>: fibers longer than 5 micrometers per cubic centimeter of air.

\*\*OSHA TWA standards are based on up to an 8-hour exposure; substances followed by the designation "skin" refer to the potential contribution to the overall exposure by the cutaneous route.

\*\*\*NIOSH recommended TWA standards are based on up to a 10-hour exposure unless otherwise noted; NIOSH recommended ceiling standards are based on a 15-minute exposure unless otherwise noted.

§Indicates no existing NIOSH recommended standard.

§§Indicates no existing OSHA standard.