OEHHA
Office of Environmental Health Hazard Assessment

Air Toxicology and Epidemiology

All OEHHA Acute, 8-hour and Chronic Reference Exposure Levels (chRELs) as of June 2014

Follow the links below to download documentation on the reference exposure levels.

Footnotes:
[1]REL types: **A** = acute, **8** = 8-hour, **C** = chronic. Exposure averaging time for acute RELs is 1 hour. For 8-hour RELs, the exposure averaging time is 8 hours, which may be repeated. Chronic RELs are designed to address continuous exposures for up to a lifetime: the exposure metric used is the annual average exposure.

[2]Species used in key study for REL development: D = dog; Gb = gerbil; GP = guinea pig: H = human; Ha = hamster; M = mouse; Mk = monkey; R = rat; Rb = rabbit

[3]These peer-reviewed chronic REL values were developed under the Toxic Air Contaminant (TAC) Program mandated by AB1807.

[4]REL based on benchmark dose (BMC) approach.

[5]REL developed using the revised methodology (OEHHA, 2008)].

OEHHA Acute, 8-hour and Chronic Reference Exposure Level (REL) Summary[1]					
Substance	**REL type** *[1]*	**Inhalation REL (ug/m3)**	**Oral REL (ug/kg BW-day)**	**Hazard Index Target Organs**	**Species** *[2]*
Acetaldehyde (75-07-0)	**A**	470[5]		Eyes; respiratory system (sensory irritation)	H
	8	300[4,5]		Respiratory system	R
	C	140[4,5]		Respiratory system	R
Acrolein (107-02-8)	**A**	2.5[5]		Eyes, respiratory system (sensory irritation)	H
	8	0.7[5]		Respiratory system	R
	C	0.35[5]		Respiratory system	R
Acrylic Acid (79-10-7)	**A**	6,000		Respiratory system; eyes	R
Acrylonitrile (107-13-1)	**C**	5[4]		Respiratory system	R

Ammonia (7664-41-7)	A	3200[4]		Respiratory system; eyes	H
	C	200		Respiratory system	H
Arsenic (7440-38-2) **& inorganic arsenic compounds (including arsine)**	A	0.20[5]		Development; cardiovascular system; nervous system	M
	8	0.015[5]		Development; cardiovascular system; nervous system; respiratory system; skin	H
	C	0.015[5]	0.0035[5]	*Inhalation & oral*: Development; cardiovascular system; nervous system; respiratory system; skin	H
Benzene (71-43-2)	A	27		Developmental; Immune system; Hematologic system	M
	8	3		Hematologic system	H
	C	3		Hematologic system	H
Benzyl Chloride(100-44-7)	A	240		Respiratory system; eyes	M, R
Beryllium& beryllium compounds (7440-41-7)	C	0.007	2.0	Inhalation: Respiratory system; immune system Oral: Alimentary system (Gastrointestinal tract)	H
Butadiene (106-99-0)	A	660[4,5]		Development	M
	8	9[4,5]		Reproductive system	M
	C	2[4,5]		Reproductive system	M
Cadmium & cadmium compounds (7440-43-9)	C	0.02	0.5	Inhalation: Kidney; respiratory system Oral: kidney	H
Carbon disulfide (75-15-0)	A	6,200		Reproductive/ Development; nervous system	R
	C	800[4]		Nervous system; reproductive system	H
Carbon monoxide (630-08-0)	A	23,000		Cardiovascular system	H

	A	50		Eyes (sensory irritation)	H
Caprolactam (105-60-2)	**8**	7		Respiratory system	R
	C	2.2		Respiratory system	R
Carbon tetrachloride (56-23-5)	A	1,900		Alimentary system (liver); Reproductive/ Developmental; nervous system	R
	C	40		Alimentary and nervous systems; development	GP
Chlorinated dibenzo-p dioxins and dibenzofurans Unspeciated mixtures treated as 2,3,7,8-tetrachlorodibenzo-p-dioxin (1746-01-6)	**C**	0.00004	1×10^{-5}	Inhalation and Oral: Alimentary (liver) reproductive, endocrine, respiratory, hematologic systems; development	R
Chlorine (7782-50-5)	A	210		Respiratory system; eyes	H
	C	0.2[4]		Respiratory system	R
Chlorine dioxide (10049-04-4)	**C**	0.6		Respiratory system	R
Chlorobenzene (108-90-7)	**C**	1,000		Alimentary system (liver); kidney; reproductive system	R
Chloroform (67-66-3)	A	150		Reproductive/ Developmental; respiratory system; nervous system	R
	C	300		Alimentary system; kidney; development	R
Chloropicrin (76-06-2)	A	29		Respiratory system; eyes	M
	C	0.4[4]		Respiratory system	M
Chromic trioxide (as chromic acid mist)	**C**	0.002	20	Inhalation: Respiratory system Oral: Hematologic system	H
Chromium (hexavalent) (18540-29-9) & soluble hexavalent chromium compounds (except chromic trioxide)	**C**	0.2[4]	20	Inhalation: Respiratory system Oral: Hematologic system	R
Copper and compounds	**A**	100		Respiratory system	H

Cresol mixtures (1319-77-3)	C	600		Nervous system	R
Dichlorobenzene (1,4-) (106-46-7)	C	800		Nervous and respiratory; alimentary systems (liver); kidney	R
Dichloroethylene (1,1) (75-35-4)	C	70		Alimentary system (liver)	GP
Diesel Exhaust	C	5[3]		Respiratory system	R
Diethanolamine (111-42-2)	C	3		Respiratory and hematologic systems	R
Dimethylformamide (N,N-) (68-12-2)	C	80		Alimentary (liver) and respiratory systems	H
Dioxane (1,4-) (123-91-1)	A	3,000		Respiratory system; eyes	H
	C	3,000		Alimentary system; kidney; cardiovascular system	R
Epichlorohydrin (106-89-8)	A	1,300		Respiratory system; eyes	H
	C	3		Respiratory system; eyes	R
Epoxybutane (1,2-) (106-88-7)	C	20		Respiratory system; cardiovascular system	M
Ethylbenzene(100-41-4)	C	2,000		Alimentary system (liver); kidney; endocrine system; development	M, R
Ethyl chloride (75-00-3)	C	30,000		Development; alimentary system (liver)	M
Ethylene dibromide (106-93-4)	C	0.8		Reproductive system	H
Ethylene dichloride (107-06-2)	C	400		Alimentary system (liver)	R
Ethylene glycol (107-21-1)	C	400		Respiratory system; kidney; development	H
Ethylene glycol monobutyl ether (111-76-2)	A	14,000		Respiratory system; eyes	H
Ethylene glycol monoethyl ether (110-80-5)	A	370		Reproductive/ Development	R
	C	70		Reproductive system; hemotologic system	Rb

Ethylene glycol monoethyl ether acetate (111-15-9)	**A**	140		Reproductive/ Development; nervous system	R
	C	300		Development	Rb
Ethylene glycol monomethyl ether (109-86-4)	**A**	93		Reproductive/ Development	R
	C	60		Reproductive system	Rb
Ethylene glycol monomethyl ether acetate (110-49-6)	**C**	90		Reproductive system	Rb
Ethylene oxide (75-21-8)	**C**	30		Nervous system	R
Fluorides (except Hydrogen Fluoride - listed below separately)	**C**	13[4]	40	Inhalation: Bone and teeth; respiratory system Oral: Bone and teeth	H
Formaldehyde (50-00-0)	**A**	55[5]		Eyes (Sensory irritation)	H
	8	9[5]		Respiratory system	H
	C	9[5]		Respiratory system	H
Glutaraldehyde (111-30-8)	**C**	0.08[4]		Respiratory system	M
Hexane (n-)(110-54-3)	**C**	7000		Nervous system	H
Hydrazine (302-01-2)	**C**	0.2		Alimentary system (liver); endocrine system	Ha
Hydrogen chloride (7647-01-0)	**A**	2,100		Respiratory system; eyes	H
	C	9		Respiratory system	H
Hydrogen cyanide (74-90-8)	**A**	340		Nervous system	H
	C	9		Nervous system; endocrine system; cardiovascular system	H
Hydrogen fluoride (7664-39-3)	**A**	240		Respiratory system; eyes	H
	C	14[4]	40	Inhalation: Bone and teeth; respiratory system (See “fluorides” summary)	H

				Oral: Bone and teeth	
Hydrogen selenide (7783-07-5)	A	5		Respiratory system; eyes	GP
Hydrogen sulfide (7783-06-4)	A	42		Nervous system	H
	C	10		Respiratory system	M
Isophorone (78-59-1)	C	2,000		Development; alimentary system (liver)	R, M
Isopropanol (67-63-0)	A	3,200		Eyes; respiratory system	H
	C	7,000		Kidney; development	R, M
Maleic anhydride (108-31-6)	C	0.7[4]		Respiratory system	R,Ha, Mk
Manganese (7439-96-5) & manganese compounds	8	0.17[4,5]		Nervous system	H
	C	0.09[4,5]		Nervous system	H
Mercury (7439-97-6) & inorganic mercury compounds	A	0.6[5]		Nervous system; development	R
	8	0.06[5]		Nervous system; development; kidney	H
	C	0.03[5]	0.16[5]	Inhalation & Oral: Nervous system; development; kidney	H
Methanol (67-56-1)	A	28,000		Nervous system	H
	C	4,000[4]		Development	M
Methyl bromide (74-83-9)	A	3900		Nervous system; respiratory system; Reproductive/ development	H
	C	5		Respiratory system; nervous system; development	R
Methyl chloroform (71-55-6)	A	68,000		Nervous system	H
	C	1000		Nervous system	Gb
Methylene chloride (75-09-2)	A	14,000			H

				Cardiovascular system; Nervous system	
	C	400		Cardiovascular system; nervous system	H
Methylene dianiline (4,4'-) (101-77-9)	C	20		Eyes; alimentary system (liver)	GP
Methylene diphenyl isocyanate (101-68-8)	C	0.7[4]		Respiratory system	R
Methyl ethyl ketone (78-93-3)	A	13,000		Respiratory system; eyes	H
Methyl isocyanate (624-83-9)	C	1		Respiratory system; reproductive system	R
Methyl *t*-butyl ether (1634-04-4)	C	8,000		Kidney; eyes; alimentary system (liver)	R
Naphthalene (91-20-3)	C	9		Respiratory system	H
Nickel & nickel compounds (except nickel oxide for chronic inhalation exposures) (Inhalation concentrations as µg Ni/m3: oral dose as µg Ni/kg-day)	A	0.2[5]		Immune system	M
	8	0.06[5]		Respiratory, immune systems	R
	C	0.014[5]	11 [5]	*Inhalation:* Respiratory system; hematologic system *Oral:* Development	R
Nickel oxide (1313-99-1) (Inhalation concentration as µg Ni/m3: oral dose as µg Ni/kg-day)	C	0.02[5]	11[5]	*Inhalation:* Respiratory system *Oral:* Development	M R
Nitric acid (7697-37-2)	A	86		Respiratory system	H
Nitrogen dioxide (10102-44-0)	A	470		Respiratory system	H
Ozone (10028-15-6)	A	180		Respiratory system; eyes	H
Perchloroethylene (127-18-4) (*syn.* **Tetrachloroethylene**)*[3]*	A	20,000		Nervous system; respiratory system; eyes	H
	C	35		Kidney; alimentary system (liver)	M
Phenol (108-95-2)	A	5,800		Respiratory system; eyes	H
	C	200		Alimentary system; cardiovascular system; kidney; nervous system	R

Phosgene (75-44-5)	**A**	4		Respiratory system	R
Phosphine (7803-51-2)	**C**	0.8		Respiratory system; alimentary system (liver); nervous system; kidney; hematologic system	M
Phosphoric acid (7664-38-2)	**C**	7[4]		Respiratory system	R
Polychlorinated biphenyls (PCBs) Individual congeners evaluated using TEF methodology, relative to as 2,3,7,8-tetrachlorodibenzo-p-dioxin (see Appendix C in the TSD for Cancer Potency Factors – online at: http://oehha.ca.gov/air/hot_spots/tsd052909.html	**C**	-	-	*Inhalation & oral*: Alimentary (liver) reproductive, endocrine, respiratory, hematologic systems; development	R
Phthalic anhydride (85-44-9)	**C**	20		Respiratory system	H
Propylene(115-07-1)	**C**	3,000		Respiratory system	R
Propylene glycol monomethyl ether (107-98-2)	**C**	7,000		Alimentary system (liver)	R
Propylene oxide (75-56-9)	**A**	3,100		Respiratory system; eyes; reproductive/development	H
	C	30		Respiratory system	R
Selenium and selenium compounds (other than hydrogen selenide)	**C**	20	5	Inhalation & oral: Alimentary system (liver); cardiovascular system; nervous system	H
Silica (crystalline, respirable)	**C**	3[4]		Respiratory system	H
Sodium hydroxide (1310-93-2)	**A**	8		Respiratory system; eyes; skin	H
Styrene (100-42-5)	**A**	21,000		Respiratory system; eyes; reproductive/development	H
	C	900[4]		Nervous system	H
Sulfates	**A**	120		Respiratory system	H
Sulfur dioxide (7446-09-5)	**A**	660		Respiratory system	H
Sulfuric acid (7664-93-9) **[& oleum,** *acute only***]**	**A**	120		Respiratory system	H
	C	1		Respiratory system	Mk

Toluene (108-88-3)	A	37,000		Respiratory, nervous systems; eyes reproductive/development	H
	C	300		Nervous system; respiratory system; development	R
Toluene diisocyanates (2,4- & 2,6-)	C	0.07		Respiratory system	H
Trichloroethylene (79-01-6)	C	600		Nervous system; eyes	H
Triethylamine (121-44-8)	A	2,800		Nervous system; eyes	H
	C	200		Eyes	R
Vanadium pentoxide(1314-62-1)	A	30		Respiratory system; eyes	H
Vinyl acetate (108-05-4)	C	200		Respiratory system	R, M
Vinyl chloride (75-01-4)	A	180,000		Nervous system; respiratory system; eyes	H
Xylenes: technical mixture (1330-20-7) and o-xylene (95-47-6), m-xylene (108-38-3) and p-xylene (106-42-3) isomers.	A	22000		Nervous & respiratory systems; eyes	H
	C	700		Nervous & respiratory systems; eyes	H

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