

## 8. REGULATIONS, ADVISORIES, AND GUIDELINES

MRLs are substance specific estimates, which are intended to serve as screening levels, are used by ATSDR health assessors and other responders to identify contaminants and potential health effects that may be of concern at hazardous waste sites.

MRLs were not derived for carbon monoxide, as discussed in Section 2.3.

EPA (IRIS 2009) has not established an oral reference dose (RfD) or an inhalation reference concentration (RfC) for carbon monoxide.

The International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP), and EPA have not classified carbon monoxide for human carcinogenicity (IARC 2009; IRIS 2009; NTP 2005).

OSHA has required employers of workers who are occupationally exposed to carbon monoxide to institute engineering controls and work practices to reduce and maintain employee exposure at or below permissible exposure limits (PELs) (OSHA 2009). The employer must use engineering and work practice controls to reduce exposures to not exceed  $55 \text{ mg/m}^3$  (50 ppmv) for carbon monoxide at any time (OSHA 2009).

EPA has designated carbon monoxide as a hazardous air pollutant (HAP) under the Clean Air Act (CAA) (EPA 2009c). Additionally, under the National Ambient Air Quality Standards (NAAQS), EPA is required to set limits to protect public health, including the health of "sensitive" populations, such as asthmatics, children, and the elderly. Carbon monoxide is required to not to exceed levels of 10 and  $40 \text{ mg/m}^3$  (9 and 35 ppmv) for 8- and 1-hour averaging times, respectively, and not to be exceeded more than once per year (EPA 2009d).

The international and national regulations, advisories, and guidelines regarding carbon monoxide in air, water, and other media are summarized in [Table 8-1](#).

## 8. REGULATIONS, ADVISORIES, AND GUIDELINES

**Table 8-1. Regulations, Advisories, and Guidelines Applicable to Carbon Monoxide**

Agency	Description	Information	Reference
<u>INTERNATIONAL</u>			
Guidelines:			
IARC	Carcinogenicity classification	No data	IARC 2009
WHO	Air quality guidelines		WHO 2000
	TWA based on effects other than cancer or odor/annoyance using an averaging time of:		
	15 minutes	100 mg/m <sup>3</sup> (87 ppm)	
	30 minutes	60 mg/m <sup>3</sup> (52 ppm)	
	1 hour	30 mg/m <sup>3</sup> (26 ppm)	
	8 hours	10 mg/m <sup>3</sup> (9 ppm)	
	Drinking water quality guidelines	No data	WHO 2006
<u>NATIONAL</u>			
Regulations and Guidelines:			
a. Air			
ACGIH	TLV (8-hour TWA)	29 mg/m <sup>3</sup> (25 ppm)	ACGIH 2008
	TLV-basis (critical effect)	Carboxyhemoglobinemia	
AIHA	ERPG-1 <sup>a</sup>	229 mg/m <sup>3</sup> (200 ppm)	AIHA 2008
	ERPG-2 <sup>a</sup>	401 mg/m <sup>3</sup> (350 ppm)	
	ERPG-3 <sup>a</sup>	573 mg/m <sup>3</sup> (500 ppm)	
EPA	AEGL-1 <sup>b</sup>	Not recommended due to insufficient data	EPA 2009b
	AEGL-2 <sup>b</sup>		
	10 minutes	481 mg/m <sup>3</sup> (420 ppm)	
	30 minutes	172 mg/m <sup>3</sup> (150 ppm)	
	60 minutes	95 mg/m <sup>3</sup> (83 ppm)	
	4 hours	38 mg/m <sup>3</sup> (33 ppm)	
	8 hours	31 mg/m <sup>3</sup> (27 ppm)	
	AEGL-3 <sup>b</sup>		
	10 minutes	1,948 mg/m <sup>3</sup> (1,700 ppm)	
	30 minutes	687 mg/m <sup>3</sup> (600 ppm)	
	60 minutes	378 mg/m <sup>3</sup> (330 ppm)	
	4 hours	172 mg/m <sup>3</sup> (150 ppm)	
	8 hours	149 mg/m <sup>3</sup> (130 ppm)	
	Hazardous air pollutant	No	EPA 2009c 42 USC 7412

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Agency	Description	Information	Reference
<b>NATIONAL</b> ( <i>cont.</i> )			
	National Ambient Air Quality Standards		EPA 2009d
	8-hour averaging time <sup>c</sup>	10 mg/m <sup>3</sup> (9 ppm)	
	1-hour averaging time <sup>c</sup>	40 mg/m <sup>3</sup> (35 ppm)	
NIOSH	REL (10-hour TWA)	40 mg/m <sup>3</sup> (35 ppm)	NIOSH 2005
	Ceiling	229 mg/m <sup>3</sup> (200 ppm)	
	IDLH	1,375 mg/m <sup>3</sup> (1,200 ppm)	
	Target organs	Cardiovascular system, lungs, blood, and central nervous system	
OSHA	PEL (8-hour TWA) for general industry	55 mg/m <sup>3</sup> (50 ppm)	OSHA 2009 29 CFR 1910.1000, Table Z-1
<b>b. Water</b>			
EPA	Drinking water standards and health advisories	No	EPA 2006a
	National primary drinking water standards	No	EPA 2003
	National recommended water quality criteria	No	EPA 2006b
<b>c. Food</b>			
FDA	EAFUS <sup>d</sup>	No	FDA 2008
<b>d. Other</b>			
ACGIH	Carcinogenicity classification	No	ACGIH 2008
	Biological exposure indices (end of shift)		
	Carboxyhemoglobin in blood	3.5% hemoglobin	
	Carbon monoxide in end-exhaled air	23 mg/m <sup>3</sup> (20 ppm)	
EPA	Carcinogenicity classification	No	IRIS 2009
	RfC	No	
	RfD	No	
	Superfund, emergency planning, and community right-to-know		

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Agency	Description	Information	Reference
<b>NATIONAL</b> ( <i>cont.</i> )			
	Designated CERCLA hazardous substance	No	EPA 2009e 40 CFR 302.4
	Effective date of toxic chemical release reporting	No	EPA 2009f 40 CFR 372.65
NTP	Carcinogenicity classification	No	NTP 2005

<sup>a</sup>ERPG-1 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing other than mild, transient health effects. ERPG-2 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing irreversible or other serious adverse effects. ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without life-threatening health effects (AIHA 2008).

<sup>b</sup>AEGL-1 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects; however, the effects are not disabling and are transient and reversible upon cessation of exposure. AEGL-2 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape. AEGL-3 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death (EPA 2009b).

<sup>c</sup>Not to be exceeded more than once per year.

<sup>d</sup>The EAFUS list of substances contains ingredients added directly to food that FDA has either approved as food additives or listed or affirmed as GRAS.

ACGIH = American Conference of Governmental Industrial Hygienists; AEGL = acute exposure guideline levels; AIHA = American Industrial Hygiene Association; CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; CFR = Code of Federal Regulations; EAFUS = Everything Added to Food in the United States; EPA = Environmental Protection Agency; ERPG = emergency response planning guidelines; FDA = Food and Drug Administration; GRAS = Generally Recognized As Safe; IARC = International Agency for Research on Cancer; IDLH = immediately dangerous to life or health; IRIS = Integrated Risk Information System; NIOSH = National Institute for Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; PEL = permissible exposure limit; REL = recommended exposure limit; RfC = inhalation reference concentration; RfD = oral reference dose; TLV = threshold limit values; TWA = time-weighted average; USC = United States Code; WHO = World Health Organization