CHAPTER 7. REGULATIONS AND GUIDELINES

Pertinent international and national regulations, advisories, and guidelines regarding benzene in air, water, and other media are summarized in Table 7-1. This table is not an exhaustive list, and current regulations should be verified by the appropriate regulatory agency.

ATSDR develops MRLs, which are substance-specific guidelines intended to serve as screening levels by ATSDR health assessors and other responders to identify contaminants and potential health effects that may be of concern at hazardous waste sites. See Section 1.3 and Appendix A for detailed information on the MRLs for benzene.

Table 7-1. Regulations and Guidelines Applicable to Benzene

Agency	Description	Information	Reference
	Air		
EPA	RfC, chronic	0.03 mg/m^3 (0.009 ppm)	IRIS 2003
	Provisional peer-reviewed toxicity values		EPA 2009a
	Provisional RfC, subchronic	0.08 mg/m^3 (0.03 ppm)	
WHO	Air quality guidelines		WHO 2010
	Unit risk of leukemia per 1 µg/m^3 air concentration	6x10^{-6} [a]	
	Water & Food		
EPA	Drinking water standards and health advisories		EPA 2018a
	1-Day health advisory (10-kg child)	0.2 mg/L	
	10-Day health advisory (10-kg child)	0.2 mg/L	
	DWEL	0.1 mg/L	
	Lifetime health advisory	0.003 mg/L	
	10^{-4} Cancer risk	1–10 mg/L	
	National primary drinking water regulations		EPA 2009b
	MCLG	Zero mg/L	
	MCL	0.005 mg/L	
	RfD, chronic	0.004 mg/kg/day	IRIS 2003
	Provisional peer-reviewed toxicity values		EPA 2009a
	Provisional RfD, subchronic	0.01 mg/kg/day	
WHO	Drinking water quality guidelines	0.01 mg/L	WHO 2022

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Agency	Description	Information	Reference
FDA	Substances added to food (formerly EAFUS)	Permitted for use in food-packaging adhesives (21 CFR 175.105); and permitted in the manufacture of modified hop extract, with limitations (21 CFR 172.560)	FDA 2024
	Allowable level in bottled water	0.005 mg/L	FDA 2023d
	Cancer		
HHS	Carcinogenicity classification	Known to be a human carcinogen	NTP 2021
EPA	Carcinogenicity classification	Group A[b]	IRIS 2003
	Oral slope factor	$1.5x10^{-2}$–$5.5x10^{-2}$ per (mg/kg)/day	
	Inhalation unit risk	$2.2x10^{-6}$–$7.8x10^{-6}$ per µg/m^3	
IARC	Carcinogenicity classification	Group 1[c]	IARC 2018
	Occupational		
OSHA	PEL (8-hour TWA) for general industry, shipyards, and construction	1 ppm	OSHA 2022b, 2022c, 2022d
	STEL (15-minute TWA) for general industry, shipyards, and construction	5 ppm	
	PEL (8-hour TWA)	10 ppm[d]	OSHA 2022a
	Acceptable ceiling concentration	25 ppm[d]	
	Acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift (maximum duration is 10 minutes)	50 ppm[d]	
NIOSH	REL (up to 10-hour TWA)	0.1 ppm[e]	NIOSH 2019
	STEL (15-minute TWA)	1.0 ppm[e]	
	Emergency Criteria		
NIOSH	IDLH	500 ppm[e]	NIOSH 2019
EPA	AEGLs-air		EPA 2018b
	AEGL 1[f]		
	10-minute	130 ppm	
	30-minute	73 ppm	
	60-minute	52 ppm	
	4-hour	18 ppm	
	8-hour	9.0 ppm	
	AEGL 2[f]		
	10-minute	2,000 ppm[g]	
	30-minute	1,100 ppm	
	60-minute	800 ppm	

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Agency	Description	Information	Reference
	4-hour	400 ppm	
	8-hour	200 ppm	
	AEGL 3[f]		
	10-minute	9,700 ppm[h]	
	30-minute	5,600 ppm[g]	
	60-minute	4,000 ppm[g]	
	4-hour	2,000 ppm[g]	
	8-hour	990 ppm	
DOE	PACs-air		DOE 2018a
	PAC-1[i]	52 ppm	
	PAC-2[i]	800 ppm	
	PAC-3[i]	4,000 ppm[j]	

[a]Guideline summary states that benzene is a genotoxic carcinogen in humans and no safe level of exposure can be recommended.
[b]Group A: known human carcinogen.
[c]Group 1: carcinogenic to humans.
[d]This standard applies to the industry segments exempt from the 1 ppm 8-hour TWA and 5 ppm STEL of the benzene standard at 29 CFR 1910.1028 (OSHA 2022b).
[e]NIOSH potential occupational carcinogen.
[f]Definitions of AEGL terminology are available from EPA (2018c).
[g]Value is ≥10% of the lower explosive limit (LEL), 14,000 ppm; safety considerations against the hazard of explosion must be taken into account.
[h]Value is ≥50% of the LEL; extreme safety considerations against the hazard of explosion must be taken into account.
[i]Definitions of PAC terminology are available from DOE (2018b).
[j]Value is greater ≥10% of the LEL, but <50% of the LEL.

AEGL = acute exposure guideline levels; CFR = Code of Federal Regulations; DOE = Department of Energy; DWEL = drinking water equivalent level; EAFUS = Everything Added to Food in the United States; EPA = U.S. Environmental Protection Agency; FDA = Food and Drug Administration; HHS = Department of Health and Human Services; IARC = International Agency for Research on Cancer; IDLH = immediately dangerous to life or health; IRIS = Integrated Risk Information System; LEL = lower explosive limit; MCL = maximum contaminant level; MCLG = maximum contaminant level goal; NIOSH = National Institute for Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; PAC = protective action criteria; PEL = permissible exposure limit; REL = recommended exposure limit; RfC = inhalation reference concentration; RfD = oral reference dose; STEL = short-term exposure limit; TWA = time-weighted average; WHO = World Health Organization