

CHAPTER 7. REGULATIONS AND GUIDELINES

Pertinent international and national regulations, advisories, and guidelines regarding molybdenum 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 molybdenum.

Table 7-1. Regulations and Guidelines Applicable to Molybdenum

Agency	Description	Information	Reference
Air			
EPA	RfC	No data	IRIS 2003
WHO	Air quality guidelines	Not listed	WHO 2010
Water & Food			
EPA	Drinking water standards and health advisories for molybdenum		EPA 2018a
	1-Day health advisory (10-kg child)	0.08 mg/L	
	10-Day health advisory (10-kg child)	0.08 mg/L	
	DWEL	0.2 mg/L	
	Lifetime health advisory	0.04 mg/L	
	National primary drinking water regulations	Not listed	EPA 2009b
	RfD (molybdenum)	5×10^{-3} mg/kg/day ^a	IRIS 2003
WHO	Drinking water quality guidelines	Not established ^b	WHO 2017
FDA	Substances added to food	Not listed ^c	FDA 2018
USNRC	Annual limit on intake, oral ingestion		NRC 2018
	⁹⁹ Molybdenum compounds except oxides, hydroxides, and molybdenum disulfide	2×10^3 μ Ci	
Cancer			
HHS	Carcinogenicity classification	No data	NTP 2016
EPA	Carcinogenicity classification	No data	IRIS 2003
IARC	Carcinogenicity classification		IARC 2018
	Molybdenum trioxide	Group 2B ^d	
Occupational			
OSHA	PEL (8-hour TWA) for general industry, shipyards and construction (molybdenum, as molybdenum)		OSHA 2018a , 2018b , 2018c
	Soluble compounds	5 mg/m ³	
	Insoluble compounds, total dust	15 mg/m ³	

7. REGULATIONS AND GUIDELINES

Table 7-1. Regulations and Guidelines Applicable to Molybdenum

Agency	Description	Information	Reference
NIOSH	REL (up to 10-hour TWA)	Not established ^e	NIOSH 2016a, 2016b
	IDLH (molybdenum, as molybdenum)		
	Soluble compounds	1,000 mg Mo/m ³	NIOSH 1994a
	Insoluble compounds	5,000 mg Mo/m ³	NIOSH 1994b
USNRC	Annual limit on intake, inhalation		NRC 2018
	⁹⁹ Molybdenum compounds except oxides, hydroxides, and molybdenum disulfide	3x10 ³ μCi	
	Derived air concentration		
	⁹⁹ Molybdenum compounds except oxides, hydroxides, and molybdenum disulfide	1x10 ⁻⁶ μCi/mL	
Emergency Criteria			
EPA	AEGLs-air	No data	EPA 2016
DOE	PACs-air		
	PAC-1 ^f		
	Molybdenum	30 mg/m ³	
	Ammonium heptamolybdate	2.6 mg/m ³	
	Ammonium molybdate	3.5 mg/m ³	
	Ammonium molybdate(VI) tetrahydrate	2.8 mg/m ³	
	Diammonium dimolybdate	2.6 mg/m ³	
	Diammonium molybdate	3.1 mg/m ³	
	Disodium molybdate	3.2 mg/m ³	
	Molybdenum carbide	34 mg/m ³	
	Molybdenum dioxide	40 mg/m ³	
	Molybdenum hexacarbonyl	83 mg/m ³	
	Molybdenum pentachloride	4.3 mg/m ³	
	Molybdenum trioxide	2.3 mg/m ³	
	Molybdenum(IV) sulfide	50 mg/m ³	
	Sodium molybdate dihydrate	3.8 mg/m ³	
	PAC-2 ^f		
	Molybdenum	330 mg/m ³	
	Ammonium heptamolybdate	230 mg/m ³	
	Ammonium molybdate	290 mg/m ³	
	Ammonium molybdate(VI) tetrahydrate	30 mg/m ³	
	Diammonium dimolybdate	29 mg/m ³	
	Diammonium molybdate	22 mg/m ³	
	Disodium molybdate	17 mg/m ³	
	Molybdenum carbide	360 mg/m ³	
	Molybdenum dioxide	430 mg/m ³	
	Molybdenum hexacarbonyl	920 mg/m ³	
	Molybdenum pentachloride	410 mg/m ³	
	Molybdenum trioxide	43 mg/m ³	

7. REGULATIONS AND GUIDELINES

Table 7-1. Regulations and Guidelines Applicable to Molybdenum

Agency	Description	Information	Reference
	Molybdenum(IV) sulfide	260 mg/m ³	
	Sodium molybdate dihydrate	34 mg/m ³	
	PAC-3 ^f		
	Molybdenum	2,000 mg/m ³	
	Ammonium heptamolybdate	1,400 mg/m ³	
	Ammonium molibdate	1,700 mg/m ³	
	Ammonium molybdate(VI) tetrahydrate	180 mg/m ³	
	Diammonium dimolybdate	170 mg/m ³	
	Diammonium molybdate	130 mg/m ³	
	Disodium molybdate	100 mg/m ³	
	Molybdenum carbide	2,200 mg/m ³	
	Molybdenum dioxide	2,600 mg/m ³	
	Molybdenum hexacarbonyl	5,500 mg/m ³	
	Molybdenum pentachloride	2,400 mg/m ³	
	Molybdenum trioxide	260 mg/m ³	
	Molybdenum(IV) sulfide	1,600 mg/m ³	
	Sodium molybdate dihydrate	210 mg/m ³	

^aThe RfD is based on a LOAEL of 0.14 mg/kg/day for increased uric acid levels in humans (Koval'skiy et al. 1961).

^bReason for not establishing guideline value: occurs in drinking water at concentrations well below those of health concern.

^cThe Substances Added to Food inventory replaces EAFUS and contains the following types of ingredients: food and color additives listed in FDA regulations, flavoring substances evaluated by FEMA or JECFA, GRAS substances listed in FDA regulations, substances approved for specific uses in food prior to September 6, 1958, substances that are listed in FDA regulations as prohibited in food, delisted color additives, and some substances "no longer FEMA GRAS."

^dGroup 2B: possibly carcinogenic to humans.

^eIn 1988, NIOSH provided comments to OSHA in which NIOSH questioned whether proposed PELs for particular substances, including the TWA 5 mg/m³ PEL for molybdenum (soluble compounds as molybdenum), were adequate to protect workers from recognized health hazards. At that time, NIOSH also concluded that the documentation cited by OSHA was inadequate to support a proposed PEL of 10 mg/m³ for particular substances including molybdenum (insoluble compounds as molybdenum) (NIOSH 2018).

^fDefinitions of PAC terminology are available from U.S. Department of Energy (DOE 2018a).

AEGL = acute exposure guideline level; DOE = Department of Energy; DWEL = drinking water equivalent level; EAFUS = Everything Added to Food in the United States; EPA = Environmental Protection Agency; FDA = Food and Drug Administration; FEMA = Flavor and Extract Manufacturers Association; GRAS = generally recognized as safe; 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; JECFA = Joint FAO/WHO Expert Committee on Food Additives; LOAEL = lowest-observed-adverse-effect level; 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; RfD = oral reference dose; TWA = time-weighted average; USNRC = U.S. Nuclear Regulatory Commission; WHO = World Health Organization