

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.

ATSDR has derived an acute-duration inhalation MRL of 0.0008 mg vanadium/m³ based on a LOAEL of 0.56 mg vanadium/m³ for lung inflammation in rats exposed to vanadium pentoxide 6 hours/day, 5 days/week for 13 days (NTP 2002). The MRL was derived by dividing the human equivalent concentration of the LOAEL (0.073 mg vanadium/m³) by an uncertainty factor of 90 (3 for use of a minimal LOAEL, 3 for animal to human extrapolation with dosimetric adjustments, and 10 for human variability).

ATSDR has derived a chronic-duration inhalation MRL of 0.0001 mg vanadium/m³ based on a BMCL₁₀ of 0.04 mg vanadium/m³ for degeneration of epiglottis respiratory epithelium of rats exposed to vanadium pentoxide 6 hours/day, 5 days/week for 2 years (NTP 2002). The MRL was derived by dividing the human equivalent concentration of the BMCL₁₀ (0.003 mg vanadium/m³) by an uncertainty factor of 30 (3 for animal to human extrapolation with dosimetric adjustments and 10 for human variability).

ATSDR has derived an intermediate-duration oral MRL of 0.01 mg vanadium/kg/day based on a NOAEL of 0.12 mg vanadium/kg/day for hematological and blood pressure effects in humans exposed to vanadyl sulfate for 12 weeks (Fawcett et al. 1997) and an uncertainty factor of 10 for human variability.

IRIS (2012) has derived an oral reference dose (RfD) of 0.009 mg/kg/day for vanadium pentoxide based on a NOAEL of 0.89 mg/kg/day for decreased hair cysteine levels in rats exposed to vanadium pentoxide for 2.5 years (Stokinger et al. 1953) and an uncertainty factor of 100 (10 for extrapolation from animals to humans and 10 to protect against unusually susceptible individuals).

EPA has not derived an inhalation reference concentration (RfC) for vanadium and vanadium compounds.

Vanadium pentoxide, vanadyl sulfate dehydrate, and ammonium metavanadate are on the list of chemicals appearing in "Toxic Chemicals Subject to Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986" and have been assigned a reportable quantity (RQ) limit of 1,000 pounds each (EPA 2001b). Vanadium pentoxide is also considered to be an extremely hazardous

8. REGULATIONS AND ADVISORIES

substance (EPA 2011c). The RQ represents the amount of a designated hazardous substance which, when released to the environment, must be reported to the appropriate authority.

The international and national regulations, advisories, and guidelines regarding vanadium and compounds in air, water, and other media are summarized in Table 8-1.

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations, Advisories, and Guidelines Applicable to Vanadium and Compounds

Agency	Description	Information	Reference
<u>INTERNATIONAL</u>			
Guidelines:			
IARC	Carcinogenicity classification Vanadium pentoxide	Group 2B ^a	IARC 2009
WHO	Air quality guidelines Vanadium TWA based on effects other than cancer or odor/annoyance using an averaging time of 24 hours	1 µg/m ³	WHO 2000
	Drinking water quality guidelines	No data	WHO 2006
<u>NATIONAL</u>			
Regulations and Guidelines:			
a. Air			
ACGIH	TLV (8-hour TWA) ^b Vanadium pentoxide (respirable fraction of dust or fume, as V ₂ O ₅) TLV Basis	0.05 mg/m ³ Irritation and lung	ACGIH 2008
AIHA	ERPG values	No	AIHA 2008
EPA	Second AEGL chemical priority list Vanadium and compounds Hazardous air pollutant	Yes ^c No	EPA 2012 EPA 2010 42 USC 7412
NIOSH	REL (15-minute ceiling) Vanadium compounds ^a REL (TWA) Vanadium metal and vanadium carbide IDLH Target organ	0.05 mg/m ³ 1 mg/m ³ 35 mg/m ³ Eyes, skin, and respiratory system	NIOSH 2012
OSHA	PEL (ceiling limit) for general industry Vanadium pentoxide Respirable dust (as V ₂ O ₅) Fume (as V ₂ O ₅)	0.5 mg/m ³ 0.1 mg/m ³	OSHA 2011 29 CFR 1910.1000, Table Z-1

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations, Advisories, and Guidelines Applicable to Vanadium and Compounds

Agency	Description	Information	Reference
<u>NATIONAL</u> (cont.)			
b. Water			
EPA	Designated as hazardous substances in accordance with Section 311(b)(2)(A) of the Clean Water Act		EPA 2011f 40 CFR 116.4
	Vanadium pentoxide	Yes	
	Vanadyl sulfate dehydrate	Yes	
	Drinking water contaminant candidate list		EPA 1998b 63 FR 10274
	Vanadium	Yes	
EPA	Drinking water standards and health advisories	No	EPA 2006a
	National primary drinking water standards	No	EPA 2003b
	National recommended water quality criteria	No	EPA 2006b
	Reportable quantities of hazardous substances designated pursuant to Section 311 of the Clean Water Act		EPA 2011a 40 CFR 117.3
	Vanadium pentoxide	1,000 pounds	
	Vanadyl sulfate dehydrate	1,000 pounds	
c. Food			
FDA	EAFUS ^e	No	FDA 2008
d. Other			
ACGIH	Carcinogenicity classification	A4 ^f	ACGIH 2008
	Biological exposure indices (end of shift at end of workweek)		
	Vanadium in urine	50 µg/g creatinine	
EPA	Carcinogenicity classification	No	IRIS 2012
	RfC	No	
	RfD		
	Vanadium pentoxide	9x10 ⁻³ mg/kg/day	
	Superfund, emergency planning, and community right-to-know		
	Designated CERCLA hazardous substance and their reportable quantities		EPA 2011b 40 CFR 302.4
	Vanadium pentoxide ^g	1,000 pounds	
	Vanadyl sulfate ^h	1,000 pounds	
	Vanadic acid, ammonium salt ⁱ	1,000 pounds	

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations, Advisories, and Guidelines Applicable to Vanadium and Compounds

Agency	Description	Information	Reference
<u>NATIONAL</u> (cont.)			
	Effective date of toxic chemical release reporting		EPA 2011d 40 CFR 372.65
	Vanadium (except when contained in an alloy)	01/01/2000	
	Extremely hazardous substance and its threshold planning quantity		EPA 2011c 40 CFR 355, Appendix A
	Vanadium pentoxide	100/10,000 pounds	
	TSCA chemical lists and reporting periods		EPA 2011e 40 CFR 712.30
	Vanadium, vanadium pentoxide, vanadyl sulfate pentahydrate, sodium metavanadate, sodium orthovanadate, and ammonium metavanadate		
	Effective date	07/11/2003	
	Reporting date	09/09/2003	
DHHS	Carcinogenicity classification	No data	NTP 2011
IOM	Upper Tolerable Limit	1.8 mg/day	IOM 2001

^aGroup 2B: possibly carcinogenic to humans

^bVanadium peroxide is included in the 2008 Notice of Intended Changes in which the substance and its corresponding values and notations for which the withdrawal of the Documentation and adopted TLV are proposed.

^cVanadium and compounds are included on the list of 371 priority chemicals that are acutely toxic and represent the selection of chemicals for AEGL development by the NAC/AEGL committee during the next several years.

^dThe REL applies to all vanadium compounds except vanadium metal and vanadium carbide.

^eThe EAFUS list of substances contains ingredients added directly to food that FDA has either approved as food additives or listed or affirmed as GRAS.

^fA4: not classifiable as a human carcinogen

^gDesignated CERCLA hazardous substance pursuant to Section 311(b)(2) of the Clean Water Act and Section 3001 of the Resource Conservation and Recovery Act.

^hDesignated CERCLA hazardous substance pursuant to Section 311(b)(2) of the Clean Water Act.

ⁱDesignated CERCLA hazardous substance pursuant to Section 3001 of the Resource Conservation and Recovery Act.

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; DHHS = Department of Health and Human Services; EAFUS = Everything Added to Food in the United States; EPA = Environmental Protection Agency; ERPG = emergency response planning guidelines; FDA = Food and Drug Administration; FR = Federal Register; GRAS = Generally Recognized As Safe; IARC = International Agency for Research on Cancer; IDLH = immediately dangerous to life or health; IRIS = Integrated Risk Information System; IOM = Institute of Medicine; NAC = National Advisory Council; 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; TSCA = Toxic Substances Control Act; TWA = time-weighted average; USC = United States Code; WHO = World Health Organization