

8. REGULATIONS AND ADVISORIES

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

No MRLs were derived for inhalation or oral exposure to tungsten or tungsten compounds.

EPA has not classified tungsten or tungsten compounds for carcinogenicity, nor has the EPA derived reference concentrations (RfCs) or reference doses (RfDs) for tungsten or tungsten compounds (IRIS 2005). EPA regulates the effluent discharge of tungsten at primary tungsten facilities (EPA 2005a) and tungsten or cobalt at secondary tungsten and cobalt facilities processing tungsten or tungsten carbide scrap raw materials (EPA 2005b).

The American Conference of Governmental Industrial Hygienists (ACGIH), National Institute of Occupational Safety and Health (NIOSH), and Occupational Safety and Health Administration (OSHA) regulate tungsten for occupational exposures.

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Table 8-1. Regulations and Guidelines Applicable to Tungsten

Agency	Description	Information	Reference
<u>INTERNATIONAL</u>			
Guidelines:			
IARC	Carcinogenicity classification	No data	
WHO	Drinking water and air quality guidelines	No data	
<u>NATIONAL</u>			
Regulations and Guidelines:			
a. Air:			
ACGIH	TLV (8-hour TWA) Tungsten (as W) Metal and insoluble compounds	5 mg/m ³	ACGIH 2003
	STEL	10 mg/m ³	
	Soluble compounds	1 mg/m ³	
	STEL	3 mg/m ³	
NIOSH	REL (10-hour TWA) Tungsten (also applies to insoluble tungsten compounds [as W])	5 mg/m ³	NIOSH 2005
	STEL (15-minute TWA)	10 mg/m ³	
OSHA	PEL (8-hour TWA) for general industry	No data	
	PEL (8-hour TWA) for construction industry Tungsten (as W)		OSHA 2005b 29 CFR 1926.55, Appendix A
	Insoluble compounds	5 mg/m ³	
	Soluble compounds	1 mg/m ³	
	PEL (8-hour TWA) for shipyard industry Tungsten		OSHA 2005a 29 CFR 1915.1000
	Insoluble compounds	5 mg/m ³	
	Soluble compounds	1 mg/m ³	
USNRC	Occupational values		USNRC 2005
	Oral ingestion	ALI (μCi) ^a	10 CFR 20, Appendix B
	¹⁷⁶ W	1.0x10 ⁴	
	¹⁷⁷ W	2.0x10 ⁴	
	¹⁷⁸ W	5.0x10 ³	
	¹⁷⁹ W	5.0x10 ⁵	
	¹⁸¹ W	2.0x10 ⁴	
	¹⁸⁵ W (LLI wall)	2.0x10 ³	
	¹⁸⁵ W	3.0x10 ³	
	¹⁸⁷ W	2.0x10 ³	
	¹⁸⁸ W (LLI wall)	4.0x10 ²	
	¹⁸⁸ W	5.0x10 ²	

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Agency	Description	Information		Reference
NATIONAL (cont.)				
USNRC	Occupational values			USNRC 2005
	Inhalation ^b	<u>ALI (μCi)^a</u>	<u>DAC (μCi/mL)^c</u>	10 CFR 20, Appendix B
	¹⁷⁶ W	5.0x10 ⁴	2.0x10 ⁻⁵	
	¹⁷⁷ W	9.0x10 ⁴	4.0x10 ⁻⁵	
	¹⁷⁸ W	2.0x10 ⁴	8.0x10 ⁻⁶	
	¹⁷⁹ W	2.0x10 ⁶	7.0x10 ⁻⁴	
	¹⁸¹ W	3.0x10 ⁴	1.0x10 ⁻⁵	
	¹⁸⁵ W (LLI wall)	7.0x10 ³	3.0x10 ⁻⁶	
	¹⁸⁷ W	9.0x10 ³	4.0x10 ⁻⁶	
	¹⁸⁸ W (LLI wall)	1.0x10 ³	5.0x10 ⁻⁷	
b. Water	No data			
c. Food	No data			
d. Other				
ACGIH	Carcinogenicity classification	No data		ACGIH 2003
EPA	Carcinogenicity classification	No data		IRIS 2005
	RfC	No data		
	RfD	No data		
	Effluent guidelines and standards; nonferrous metals manufacturing point source category applicable to discharges resulting from the production of tungsten at primary tungsten facilities	Yes		EPA 2005a 40 CFR 421.100
	Effluent guidelines and standards; nonferrous metals manufacturing point source category applicable to discharges resulting from the production of tungsten or cobalt at secondary tungsten and cobalt facilities processing tungsten or tungsten carbide scrap raw materials	Yes		EPA 2005b 40 CFR 421.310
USNRC	Effluent concentrations ^d	Air <u>(μCi/mL)^e</u>	Water <u>(μCi/mL)^f</u>	USNRC 2005 10 CFR 20, Appendix B
	¹⁷⁶ W	7.0x10 ⁻⁸	1.0x10 ⁻⁴	
	¹⁷⁷ W	1.0x10 ⁻⁷	3.0x10 ⁻⁴	
	¹⁷⁸ W	3.0x10 ⁻⁸	7.0x10 ⁻⁵	
	¹⁷⁹ W	2.0x10 ⁻⁶	7.0x10 ⁻³	
	¹⁸¹ W	5.0x10 ⁻⁸	2.0x10 ⁻⁴	
	¹⁸⁵ W (LLI wall)	9.0x10 ⁻⁹	No data	
	¹⁸⁵ W	No data	4.0x10 ⁻⁵	
	¹⁸⁷ W	1.0x10 ⁻⁸	3.0x10 ⁻⁵	
	¹⁸⁸ W (LLI wall)	2.0x10 ⁻⁹	No data	
	¹⁸⁸ W	No data	7.0x10 ⁻⁶	

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Table 8-1. Regulations and Guidelines Applicable to Tungsten

Agency	Description	Information	Reference
<u>NATIONAL</u> (cont.)			
USNRC	Release to sewers ⁹	Monthly average concentration ($\mu\text{Ci/mL}$)	USNRC 2005 10 CFR 20, Appendix B
	¹⁷⁶ W	1.0×10^{-3}	
	¹⁷⁷ W	3.0×10^{-3}	
	¹⁷⁸ W	7.0×10^{-4}	
	¹⁷⁹ W	7.0×10^{-2}	
	¹⁸¹ W	2.0×10^{-3}	
	¹⁸⁵ W	4.0×10^{-4}	
	¹⁸⁷ W	3.0×10^{-4}	
	¹⁸⁸ W	7.0×10^{-5}	
<u>STATE</u>			
a. Air	No data		
b. Water	No data		
c. Food	No data		
d. Other	No data		

^aThe ALIs in this table are the annual intakes of a given radionuclide by "Reference Man", which would result in either (1) a committed effective dose equivalent of 5 rems (stochastic ALI) or (2) a committed dose equivalent of 50 rems to an organ or tissue (non-stochastic ALI). The stochastic ALIs were derived to result in a risk, due to irradiation of organs and tissues, comparable to the risk associated with deep dose equivalent to the whole body of 5 rems. The derivation includes multiplying the committed dose equivalent to an organ or tissue by a weighting factor, w_T . This weighting factor is the proportion of the risk of stochastic effects resulting from irradiation of the organ or tissue, T, to the total risk of stochastic effects when the whole body is irradiated uniformly. The non-stochastic ALIs were derived to avoid non-stochastic effects, such as prompt damage to tissue or reduction in organ function.

^bThe ALIs and DACs for inhalation are given for an aerosol with an activity median aerodynamic diameter (AMAD) of 1 μm and for class D of radioactive material, which refers to their retention (clearance half-times of <10 days) in the pulmonary region of the lung.

^cThe DAC values are derived limits intended to control chronic occupational exposures. The relationship between the DAC and the ALI is given by: $\text{DAC} = \text{ALI} (\text{in } \mu\text{Ci}) / (2,000 \text{ hours per working year} \times 60 \text{ minutes/hour} \times 2 \times 10^4 \text{ mL per minute}) = [\text{ALI} / 2.4 \times 10^9] \mu\text{Ci/mL}$, where $2 \times 10^4 \text{ mL}$ is the volume of air breathed per minute at work by "Reference Man" under working conditions of "light work." The DAC values relate to one of two modes of exposure: either external submersion or the internal committed dose equivalents resulting from inhalation of radioactive materials. Derived air concentrations based upon submersion are for immersion in a semi-infinite cloud of uniform concentration and apply to each radionuclide separately.

^dApplicable to the assessment and control of dose to the public. The concentration values given are equivalent to the radionuclide concentrations that, if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent of 0.05 rem (50 millirem or 0.5 millisievert).

^eThe air concentration values were derived by one of two methods. For those radionuclides for which the stochastic limit is governing, the occupational stochastic inhalation ALI was divided by $2.4 \times 10^9 \text{ mL}$, relating the inhalation ALI to the DAC, as explained above, and then divided by a factor of 300. The factor of 300 includes the following components: a factor of 50 to relate the 5-rem annual occupational dose limit to the 0.1-rem limit for members of the public, a factor of 3 to adjust for the difference in exposure time and the inhalation rate for a worker and that for members of the public, and a factor of 2 to adjust the occupational values (derived for adults) so that they are applicable to other age groups. For those radionuclides for which submersion (external dose) is limiting, the occupational DAC in Table 1, Column 3 of USNRC (2005), was divided by 219. The factor of 219 is composed of a factor of 50, as described above, and a factor of 4.38 relating occupational exposure for 2,000 hours per year to full-time exposure (8,760 hours/year). Note that an additional factor of 2 for age considerations is not warranted in the submersion case.

^fThe water concentrations were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by 7.3×10^7 . The factor of $7.3 \times 10^7 \text{ (mL)}$ includes the following components: the factors of 50 and 2 described above and a factor of $7.3 \times 10^5 \text{ (mL)}$, which is the annual water intake of "Reference Man."

⁹The monthly average concentrations for release to sanitary sewers are applicable to the provisions in § 20.2003.

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Agency	Description	Information	Reference

The concentration values were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by 7.3×10^6 (mL). The factor of 7.3×10^6 (mL) is composed of a factor of 7.3×10^5 (mL), the annual water intake by "Reference Man," and a factor of 10, such that the concentrations, if the sewage released by the licensee were the only source of water ingested by a reference man during a year, would result in a committed effective dose equivalent of 0.5 rem.

ACGIH = American Conference of Governmental Industrial Hygienists; ALI = annual limits on intakes; CFR = Code of Federal Regulations; DAC = derived air concentrations; EPA = Environmental Protection Agency; IARC = International Agency for Research on Cancer; LLI = lower large intestine; NIOSH = National Institute for Occupational Safety and Health; OSHA = Occupational Safety and Health Administration; PEL = permissible exposure limit; REL = recommended exposure limit; RfC = inhalation reference concentration; RfD = oral reference dose; STEL = short-term exposure limit; TLV = threshold limit values; TWA = time-weighted average; USNRC = U.S. Nuclear Regulatory Commission; WHO = World Health Organization