

## 8. REGULATIONS AND ADVISORIES

Because of its potential to cause adverse health effects in exposed people, a number of regulations and guidelines have been established for selenium by various national and state agencies. These values are summarized in Table 8-1.

The current Recommended Dietary Allowances (RDAs) for selenium, established by the Food and Nutrition Board of the National Research Council (National Academy of Sciences) (NAS 2000), are listed below. The recommended Tolerable Upper Intake Level (UL) for selenium in adults is 0.4 mg/day (NAS 2000). The UL is defined as the highest level of daily nutrient intake that is likely to pose no risk of adverse health effects to almost all individuals in the general population.

Men: 0.055 mg/day

Women: 0.055 mg/day

Pregnant women: 0.060 mg/day

Lactating women: 0.070 mg/day

Infants (0–6 months): 0.015 mg/day

Infants (7–12 months): 0.020 mg/day

Children (1–3 years): 0.020 mg/day

Children (4–8 years): 0.030 mg/day

Children (9–18 years): 0.040 mg/day

A chronic oral MRL of 0.005 mg/kg/day was derived for selenium based on a NOAEL of 0.015 mg/kg/day for disappearance of symptoms of selenosis in recovering individuals (Yang and Zhou 1994), as discussed in Section 2.3. The NOAEL was divided by an uncertainty factor of three to account for sensitive individuals. The EPA used the same human NOAEL for clinical selenosis (0.015 mg/kg/day) (Yang et al. 1989a, 1989b) and an uncertainty factor of three to derive a chronic oral reference dose (RfD) of 0.005 mg/kg/day for selenium (EPA 2003).

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**Table 8-1. Regulations and Guidelines Applicable to Selenium**

Agency	Description	Information	References
INTERNATIONAL			
Guidelines:			
IARC	Carcinogenicity classification	Group 3 <sup>a</sup>	IARC 2001
WHO	Guideline for drinking water Recommended daily intake for adults	0.01 mg/L 0.9 µg/kg body weight	WHO 2001
NATIONAL			
Regulations and Guidelines:			
a. Air			
ACGIH	TLV (8-hour TWA) Selenium and compounds Selenium hexafluoride	0.2 mg/m <sup>3</sup> 0.16 mg/m <sup>3</sup>	ACGIH 2000
EPA	Hazard rank under Section 112(g) of the Clean Air Act Amendments  Reference air concentration	42 out of 1–100, with 100 being the most toxic  3.0 µg/m <sup>3</sup>	EPA 2001a  EPA 2001b 40CFR 266, Appendix IV
NIOSH	REL (TWA) Selenium and compounds, except selenium hexafluoride	0.2 mg/m <sup>3</sup>	NIOSH 2001
OSHA	IDLH Selenium and compounds General industry PEL (TWA) Selenium and compounds Selenium hexafluoride Hydrogen selenide Construction industry PEL (TWA) Selenium and compounds Selenium hexafluoride	1.0 mg/m <sup>3</sup>  0.2 mg/m <sup>3</sup> 0.4 mg/m <sup>3</sup> 0.2 mg/m <sup>3</sup>  0.2 mg/m <sup>3</sup> 0.16 mg/m <sup>3</sup>	OSHA 2001 29CFR1910.1000, Table Z  OSHA 2001
b. Water			
EPA	MCLG	0.05 mg/L	EPA 2001c 40CFR141.51
	MCL	0.05 mg/L	EPA 2001d 40CFR141.62
	DWEL	0.2 mg/L	EPA 2000
	Health advisory—lifetime Groundwater monitoring (PQL)	0.05 mg/L 750 µg/L	EPA 2001e 40CFR264, Appendix IX
	Groundwater monitoring— concentration limits	0.01 mg/L	EPA 2001f 40CFR264.94

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Agency	Description	Information	References	
<b>NATIONAL (cont.)</b>				
EPA	Water quality standards		EPA 2001g	
	Freshwater		40CFR131.36	
	Maximum concentration	20 µg/L		
	Continuous concentration	5.0 µg/L		
	Saltwater			
	Maximum concentration	290 µg/L		
	Continuous concentration	71 µg/L		
<b>c. Food</b>				
FDA	Approved use of selenium as a food additive in animal feeds—added to feed for chickens, swine, turkeys, sheep, cattle, and ducks	≤0.3 ppm	FDA 2001a 21CFR573.920	
	Bottled water—allowable level	0.05 mg/L	FDA 2001b 21CFR165.110	
	RDA (mg/day)		NAS 2000	
	Men	0.055		
	Women	0.055		
	Pregnant women	0.060		
	Lactating women	0.070		
	Infants (0–6 months)	0.015		
	Infants (7–12 months)	0.020		
	Children (1–3 years)	0.020		
	Children (4–8 years)	0.030		
	Children (9–18 years)	0.040		
	<b>d. Other</b>			
	EPA	Carcinogenicity classification		IRIS 2001
Selenium and compounds		Group D <sup>b</sup>		
Selenium sulfide		Group B2 <sup>c</sup>		
Designation of hazardous substances			EPA 2001h 40CFR116.4	
Selenium oxide				
Sodium selenite				
Determination of reportable quantities			EPA 2001i 40CFR117.3	
Selenium oxide		10 pounds		
Sodium selenite		100 pounds		
Extremely hazardous substance			EPA 2001j 40CFR355, Appendix B	
Reportable quantity				
Hydrogen selenide		10 pounds		
Selenious acid		10 pounds		
Selenium oxychloride		500 pounds		
Threshold planning quantity				
Hydrogen selenide	10 pounds			
Selenious acid	1,000/10,000 pounds			
Selenium oxychloride	500 pounds			

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Agency	Description	Information	References
<b>NATIONAL (cont.)</b>			
EPA	Identification and listing of hazardous waste		EPA 2001k 40CFR261, Appendix VIII
	Selenium		
	Selenium and compounds		
	Selenium dioxide		
	Selenium sulfide		
	Selenium tetrakis, (dimethyl-dithiocarbamate)		
	Selenious acid		
	Selenourea		
	Thallium selenite		
	Protection standards at inactive uranium processing sites—listed constituents		EPA 2001l 40CFR192, Appendix I
	Selenium and compounds		
	Selenium dioxide		
	Selenium sulfide		
	Recommended daily allowances		EPA 2001m
	Selenium and compounds		
	Men	0.7x10 <sup>-1</sup> mg/kg/day	
	Women	0.55x10 <sup>-1</sup> mg/kg/day	
	Infants	8.7x10 <sup>-4</sup> mg/kg/day	
	Reportable quantity		EPA 2001n 40CFR302.4, Appendix A
	Selenium and compounds	1 pound	
Selenium dioxide	1,000 pounds		
Selenium sulfide	1 pound		
Selenious acid	1 pound		
Selenourea	1 pound		
Sodium selenite	1,000 pounds		
Thallium selenite	1 pound		
Reportable quantity		EPA 2001o 40CFR117.3	
Selenium oxide	10 pounds		
Sewer sludge—disposal or use standards		EPA 2001p 40CFR503.13	
Ceiling concentration	100 mg/kg		
Cumulative pollutant loading rate	100 kg/hectare		
Pollutant concentration <sup>d</sup>	100 mg/kg		
Annual pollutant loading rate	5.0 kg/hectare per 365-day period		
Toxic chemical release reporting; Community Right-to-Know; effective date	01/01/87	EPA 2001q 40CFR372.65	
<b>STATE</b>			
<b>Regulations and Guidelines:</b>			
<b>a. Air</b>			
Hawaii	HAP		BNA 2001

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Agency	Description	Information	References
<i>STATE (cont.)</i>			
Illinois	Toxic air contaminant		BNA 2001
Kansas	HAP		BNA 2001
Kentucky	HAP		BNA 2001
Maryland	Toxic air pollutant Selenium sulfide		BNA 2001
Minnesota	HAP threshold—de minimis level Selenium compounds Selenium sulfide	0.1 ton/year 0.1 ton/year	BNA 2001
Nebraska	HAP—effective date	12/15/98	BNA 2001
New Hampshire	Regulated toxic air pollutant		BNA 2001
New Mexico	Toxic air pollutant OEL Emissions	0.2 mg/m <sup>3</sup> 0.0133 mg/m <sup>3</sup>	BNA 2001
New York	HAP—selenium compounds		BNA 2001
Rhode Island	HAP		BNA 2001
South Carolina	Toxic air emissions—maximum allowable concentration Selenium compounds	1 µg/m <sup>3</sup>	BNA 2001
Vermont	Hazardous ambient air standards Annual average Action level	4.80 µg/m <sup>3</sup> 0.40 pounds/8-hours	BNA 2001
Washington	HAP—threshold levels Selenium and compounds Selenium hexafluoride Selenium sulfides	0.5 tons/year 0.5 tons/year 0.5 tons/year	BNA 2001
<b>b. Water</b>			
Alabama	Aquatic life criteria Freshwater Acute Chronic Marine Acute Chronic MCL Primary drinking water standard	20 µg/L 5.0 µg/L 300 µg/L 71 µg/L 0.05 mg/L 0.01 mg/L	BNA 2001 BNA 2001
Alaska	Groundwater cleanup level MCL	0.05 mg/L 0.05 mg/L	BNA 2001 BNA 2001
Arizona	Aquifer water quality standards Drinking water guideline MCL Water quality standards Conversion factor <sup>e</sup> for saltwater—acute criteria Conversion factor <sup>e</sup> for saltwater—chronic criteria	0.05 mg/L 45 µg/L 0.05 mg/L 0.998 0.998	BNA 2001 HSDB 2001 BNA 2001 EPA 2001r 40CFR131.38

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Agency	Description	Information	References
<u>STATE (cont.)</u>			
Colorado	Groundwater protection—MCL	0.01 mg/L	BNA 2001
	MCL	0.05 mg/L	BNA 2001
	Primary drinking water standard	0.01 mg/L	BNA 2001
Connecticut	MCL	0.05 mg/L	BNA 2001
Delaware	Groundwater protection—MCL	0.01 mg/L	BNA 2001
	Primary drinking water standard	0.01 mg/L	BNA 2001
Florida	MCL	0.05 mg/L	BNA 2001
Georgia	MCL	0.05 mg/L	BNA 2001
Hawaii	MCL	0.05 mg/L	BNA 2001
	Water quality criteria applicable to all waters		BNA 2001
	Freshwater		
	Acute	20 µg/L	
	Chronic	5.0 µg/L	
	Saltwater		
	Acute	300 µg/L	
Chronic	71 µg/L		
Illinois	Concentration shall not be exceeded in water	1.0 mg/L	BNA 2001
	Groundwater quality standard	0.01 mg/L	BNA 2001
	MCL	0.05 mg/L	BNA 2001
Indiana	MCLG	0.05 mg/L	BNA 2001
	MCL	0.05 mg/L	BNA 2001
Iowa	MCL	0.05 mg/L	BNA 2001
Kansas	Surface water quality standard		BNA 2001
	Aquatic life		
	Acute	20 µg/L	
	Chronic	5.0 µg/L	
	Agriculture		
	Livestock	50 µg/L	
	Irrigation	20 µg/L	
	Public health food		
	Procurement	6,800 µg/L	
	Domestic water supply	50 µg/L	
Kentucky	Domestic water supply use—maximum allowable instream concentration	0.05 mg/L	BNA 2001
	MCL	0.05 mg/L	BNA 2001
	Maximum groundwater contaminant level	0.01 mg/L	BNA 2001
Kentucky	Primary drinking water standard	0.01 mg/L	BNA 2001
	Warm water aquatic habitat criteria		BNA 2001
	Acute		
Chronic	20 µg/L 5.0 µg/L		

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Agency	Description	Information	References
<i>STATE (cont.)</i>			
Louisiana	Groundwater protection—MCL	0.01 mg/L	BNA 2001
Maine	Drinking water guideline	10 µg/L	HSDB 2001
Maryland	Criteria for toxic substances in surface waters		BNA 2001
	Freshwater		
	Acute	20 µg/L	
	Chronic	5.0 µg/L	
	Saltwater		
	Acute	300 µg/L	
	Chronic	71 µg/L	
	Drinking water	50 µg/L	
	MCL	0.05 mg/L	BNA 2001
	Primary drinking water standard	0.01 mg/L	BNA 2001
Massachusetts	Environmental toxicity values		BNA 2001
	Freshwater	20 µg/L	
	Acute	5.0 µg/L	
	Chronic		
	Marine		
	Acute	300 µg/L	
	Chronic	71 µg/L	
	Groundwater protection—MCL	0.01 mg/L	BNA 2001
	MCL	0.05 mg/L	BNA 2001
Michigan	MCL	0.05 mg/L	BNA 2001
	Effective date	07/30/92	
Minnesota	Drinking water guideline	30 µg/L	HSDB 2001
Mississippi	Groundwater standard	50 ppb	BNA 2001
	Water quality criteria—concentration shall not exceed	0.01 mg/L	BNA 2001
Montana	MCL	0.05 mg/L	BNA 2001
North Carolina	Fresh surface water quality standard for Class C waters	5.0 ug/L	BNA 2001
	Groundwater quality standard	0.05 mg/L	BNA 2001
Nebraska	Aquatic life		BNA 2001
	Acute	20 µg/L	
	Chronic	5.0 µg/L	
	Water supply	0.05 mg/L	BNA 2001
	MCL	0.05 mg/L	BNA 2001
New Hampshire	Groundwater quality standard	0.05 mg/L	
	MCLG	0.05 mg/L	BNA 2001
	MCL	0.05 mg/L	

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<u>STATE (cont.)</u>			
New Hampshire	Water quality criteria Protection of aquatic life Fresh acute chronic Marine acute chronic Protection of human health Water and fish ingestion	5.0 µg/L 290µg/L 71 µg/L 170 µg/L 11,000 µg/L	BNA 2001
New Mexico	MCL	0.05 mg/L	BNA 2001
Nevada	Domestic water supply Dissolved selenium	0.05 mg/L	BNA 2001
New York	MCL	0.05 mg/L	BNA 2001
North Dakota	MCL	0.05 mg/L	BNA 2001
Ohio	Groundwater concentration limit	0.01 mg/L	BNA 2001
Oklahoma	Public and private water supplies Fish and wildlife propagation Acute Chronic	0.01 mg/L 20 µg/L 5.0 µg/L	BNA 2001 BNA 2001
Rhode Island	Groundwater quality standard Preventive action limit	0.05 mg/L 0.025 mg/L	BNA 2001
South Carolina	MCL	0.05 mg/L	BNA 2001
South Dakota	Groundwater maximum allowable concentration Aquatic life value Acute Chronic	0.05 mg/L 20 µg/L 5.0 µg/L	BNA 2001 BNA 2001
Tennessee	Groundwater criteria concentration MCL	0.05 mg/L 0.05 mg/L	BNA 2001 BNA 2001
Texas	MCL	0.05 mg/L	BNA 2001
Utah	MCL Water quality Domestic Agriculture	0.05 mg/L 0.01 mg/L 0.05 mg/L	BNA 2001 BNA 2001
Vermont	Groundwater quality standards Enforcement standard Preventive action level MCLG MCL	50 µg/L 25 µg/L 0.05 mg/L 0.05 mg/L	BNA 2001 BNA 2001

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Agency	Description	Information	References
<i>STATE (cont.)</i>			
Vermont	Water quality criteria for protection of aquatic organisms Maximum allowable concentration Acute Average allowable concentration Chronic	20 µg/L 5.0 µg/L	BNA 2001
Virginia	Groundwater protection levels Protection level Monitoring level MCL Surface water criteria Freshwater Acute Chronic Saltwater Acute Chronic Human health Public water supplies All other surface waters	10 µg/L 5.0 µg/L 0.01 mg/L 20 µg/L 5.0 µg/L 300 µg/L 71 µg/L 170 µg/L 11,000 µg/L	BNA 2001 BNA 2001 BNA 2001 BNA 2001
Washington	MCL	0.05 mg/L	BNA 2001
Wisconsin	Groundwater quality standards Enforcement standard Preventive action limit MCL	50 µg/L 10 µg/L 0.05 mg/L	BNA 2001 BNA 2001 BNA 2001
Wyoming	Water quality Aquatic life Acute Chronic Human health	20 µg/L 5.0 µg/L 10 µg/L	BNA 2001
c. Food			
New York	Bottled water sampling requirements—MCL	0.01 mg/L	BNA 2001
d. Other			
Alabama	Identification and listing of hazardous waste		BNA 2001
Arizona	Soil remediation levels Residential Non-residential	380 mg/kg 8,500 mg/kg	BNA 2001
California	Hazardous waste injection restrictions—waste specific prohibitions Selenium and/or compounds	100 mg/L	EPA 2001s 40CFR148.12 (b)(2)

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**Table 8-1. Regulations and Guidelines Applicable to Selenium**

Agency	Description	Information	References
<i>STATE (cont.)</i>			
California	Known to cause cancer or reproductive toxicity—initial appearance of chemical on list Selenium sulfide	10/01/89	BNA 2001
	Total threshold limit concentration	10,000 mg/kg	BNA 2001
Delaware	Regulated toxic substance—sufficient quantity Selenium hexafluoride	900 pounds/hour	BNA 2001
Florida	Toxic substance in the workplace Hydrogen selenium Selenium Selenium hexafluoride Selenium oxychloride Selenium sulfide		BNA 2001
Hawaii	Restricted use pesticides Selenium compounds	All concentrations	BNA 2001
Kentucky	Threshold planning quantity Hydrogen selenide Selenious acid Selenium oxychloride	10 pounds 1,000/10,000 pounds 500 pounds	BNA 2001
Massachusetts	Oil and hazardous material Selenious acid Selenium and compounds Selenium dioxide Selenium disulfide Selenium oxide Selenium oxychloride Selenium sulfide Selenourea		BNA 2001
Minnesota	RfD Health risk limit	0.005 mg/kg/day 30 µg/L	BNA 2001
New Hampshire	Restricted use pesticide	All concentrations	BNA 2001
New Jersey	Extraordinary hazardous substance—threshold quantity Selenium hexafluoride	700 pounds	BNA 2001

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Agency	Description	Information	References
<i>STATE (cont.)</i>			
Oregon	Toxic substance—de minimis concentration	1.0 percent	BNA 2001
Vermont	Restricted use pesticide Selenium and compounds	All concentrations	BNA 2001

<sup>a</sup>Group 3: not classifiable as to its carcinogenicity to humans

<sup>b</sup>Group D: not classifiable as to its carcinogenicity to humans

<sup>c</sup>Group B2: probable human carcinogen

<sup>d</sup>Monthly average concentrations

<sup>e</sup>Conversion factors are based on a hardness of 100 mg/L as calcium carbonate

ACGIH = American Conference of Governmental Industrial Hygienists; BNA = Bureau of National Affairs; CFR = Code of Federal Regulations; DWEL = drinking water equivalent level; EPA = Environmental Protection Agency; FDA = Food and Drug Administration; HAP = hazardous air pollutant; IARC = International Agency for Research on Cancer; IDLH = immediately dangerous to life and health; IRIS = Integrated Risk Information System; MCL = maximum contaminant level; MCLG = maximum contaminant level goal; NIOSH = National Institute for Occupational Safety and Health; OEL = occupational exposure limit; OSHA = Occupational Safety and Health Administration; PEL = permissible exposure limit; PQL = practical quantitation limit; RDA = recommended daily allowance; REL = recommended exposure limit; RfD = reference dose; TLV = threshold limit value; TWA = time-weighted average; WHO = World Health Organization