



## CADMIUM

### Identity

Name (parent)	Cadmium
UN number	2570
CAS number	7440-43-9
Intervention value (AGW in mg/m <sup>3</sup> )	-
Structure	Cd

### Occurrence

Chemical state (at 20°C)	Solid
Physical appearances	Soft, silvery and ductile metal
Industrial products	Batteries, pigments, metal coatings, plastics, metal alloys

### Physicochemical properties

Molecular weight	112.4
Vapor pressure (mbar at 25°C)	negligible
Water solubility (in mg/L at 25 °C)	Metallic form: scarcely soluble. Cadmium salts and oxides maybe soluble in water.

### Toxicokinetics (parent)

Uptake by inhalation	Uptake ranges from 25% - 50% after exposure to cadmium fumes [1, 2]. Cadmium absorption depends on the particle size and the solubility of the cadmium compound.
Uptake by skin absorption	Approximately 0.1–0.6% of the cadmium chloride in water entered the plasma perfusate through human cadaver skin over a 16-hour perfusion period, 2.4–12.7% of the applied dose remained in the skin [3].
Uptake via gastrointestinal tract	Absorption of cadmium is about 2 - 8%. Absorption is enhanced by dietary deficiencies of calcium, iron, zinc and copper and by diets low in proteins [1, 5].
Distribution	Approximately 50 % of the body burden of cadmium is in the liver and kidneys. In blood 90% of cadmium is bound to red blood cells. Substantial storage also occurs in skin, bones and muscle [1].
Metabolism	n/a
Excretion via lungs	n/a
Excretion via urine	About 0.009% of the total body burden is excreted in urine on a daily basis [4]. The amount excreted is proportional to the body burden [1].
Excretion via feces	About 0.007% of the total body burden is excreted daily [4].

### Toxicodynamics

Mechanisms of toxicity	Nephrotoxicity (the kidney is the critical organ), reprotoxicity. Acute effects of ingestion of very high cadmium doses: irritation of the stomach, diarrhea, death.
Classifications for carcinogenicity	Group 1: carcinogenic to humans [6]; it is currently believed that only inhalation exposure is carcinogenic [2].
Classifications for reprotoxicity	Cadmium is reprotoxic: animal studies show that cadmium affects both reproduction (male and female) and the development of the embryo and fetus [7].
Classifications for sensitizing properties	n/a



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### Biological monitoring

Biomarkers	Cadmium in urine (reflects the body burden)	Cadmium in blood (reflects recent exposure and body burden)
	In workers newly exposed to cadmium, a time lag is observed before cadmium in urine correlates with exposure. Therefore, after an accident blood analysis are preferred. If measurements are repeated over a period of years, urine cadmium can be used.	
Molecular weight	112.4	112.4
Involved enzymatic metabolism	-	-
Biological material	Urine	Blood
Type of sample	Spot urine	Whole blood (serum or plasma is not suitable)
Sampling strategy	Not critical	Not critical
Excretion pattern	10 – 20 years (monophasic) [1]	Bi-phasic: approximately 3 month (75 – 128 days) and 7.4 – 16.0 years [8, 9]
Materials	Polypropylene containers pre-rinsed with 10% nitric acid	Metal-free syringes with anti-coagulant (EDTA or heparin)
Transportation	At 4°C	At 4°C (maximum 1 day)
Storage	4°C	-20°C
Stability	15 days at 4°C	For 2 month at -20°C for 2 month
Measurement principle	- Graphite furnace absorption spectroscopy with Zeeman correction (GF-AAS); standard addition method - Inductively coupled plasma–mass spectrometer (ICP-MS) [10]	- ICP-MS [11] [10] - GF-AAS
Limit of quantification	0.05 µg/L (limit of detection) (GF-AAS) [12] 0.1 µg/L (limit of detection) (ICP-MS) [10]	0.09 µg/L (limit of detection) (ICP-MS) [11] 0.2 µg/L (limit of detection) (ICP-MS) [10] 0.12 µg/L (limit of quantification) (GF-AAS) [13]
Aliquot for 1 analysis	10 mL (minimum: 5 mL )	5 mL
Recommended adjustments	Urinary creatinine	-
Preferred units for expression of results	µg/ L urine or µg/g creatinine	µg/ L whole blood
Conversion factor	1 µmol Cd/ mol creatinine = 0.99 µg/ g creatinine 1 µg/ g creatinine = 1.01 µmol Cd/ mol creatinine 1 µg Cd/L urine = $8.90 \times 10^{-3}$ µmol Cd/ L urine 1 µmol Cd/ L urine = 112.4 µg Cd/L urine	1 µg Cd/L whole blood = $8.90 \times 10^{-3}$ µmol Cd/ L whole blood 1 µmol Cd/ L whole blood = 112.4 µg Cd/L whole blood
Biological exposure value US (BEI) [14]	5 µg/g creatinine	5 µg/L whole blood
Biological Tolerance Value Germany [15]	7 µg Cd/L urine	-

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Reference value	< 2 µg Cd/ g creatinine [1]	< 5 µg Cd/ L blood (smokers) < 1 µg Cd/ L blood (non-smokers) [1]
BIOMONECS background in non-smoking m/f adults (based on P0.95) [16]	0.39 µg Cd/g creatinine 0.36 µg Cd/L urine	-
Possible confounders	Renal damage: marked increase in cadmium excretion in urine Active smoking, occupational exposure. Unacceptable samples: within 48 hours after treatment with gadolinium contrast media (used in MRI).	Active smoking, occupational exposure Unacceptable samples: within 48 hours after treatment with gadolinium contrast media (used in MRI).

**References**

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