

The ToxGuide™ is developed to be used as a pocket guide. Tear off at perforation and fold along lines.

## Sources of Exposure

### General Populations

- The primary routes of exposure of humans to barium are consumption of food, water, and inhalation of ambient air.
- Populations that might receive increased exposure to barium are consumers of crops grown on soils that have been used for the land farming of waste oil-well drilling muds.
- Individuals who work at or live near barium mining, manufacturing, or processing plants might inhale higher ambient air concentrations or increased amounts of fugitive dust containing barium particulates.
- Populations living in the vicinity of the NPL sites known to be contaminated with barium may also be exposed to higher than background levels of the compound through contact with contaminated waste site media or barium in offsite air or water.
- Individuals who use barium containing depilatories (hair removing creams).

### Occupational Populations

- Occupational exposure to barium primarily occurs in workers and miners who inhale barium sulfate (or the ore, barite) and barium carbonate dust during the mining of barite and the manufacturing and processing (e.g., mixing, grinding, and loading) of barium compounds.

## Toxicokinetics and Normal Human Levels

### Toxicokinetics

- Aerosols of soluble barium compounds are well-absorbed from the lungs.
- Ingested soluble barium compounds are absorbed at a rate of ~ 8%.
- Approximately 90% of the body burden of barium is contained in the bones and teeth.
- The primary route of excretion from the body is the feces. Normally, barium is reabsorbed by the renal tubules, making the urine a relatively minor route of excretion from the body. The elimination half-life of an absorbed dose of barium is about 3 to 4 days.

### Normal Human Levels

#### Urine

- 1.64 µg/L (geometric mean, adult males, ≥20 years of age, NHANES 2001-2002).
- 1.43 µg/L (geometric mean, adult females, ≥20 years of age, NHANES 2001-2002).
- 1.80 µg/L (geometric mean, children, 6-11 years of age, NHANES 2001-2002).
- 1.30 µg/g creatinine in adult males, ≥20 years of age.
- 1.59 µg/g creatinine in adult females, ≥20 years of age.
- 2.20 µg/g creatinine (geometric mean, children, 6-11 years of age, NHANES 2001-2002).

## Biomarkers/Environmental Levels

### Biomarkers

- The organs most sensitive to the toxic effects of barium are the organs of the cardiovascular and gastrointestinal systems, muscles, and nerves. Gastrointestinal disturbances are usually the first symptoms of acute barium exposure.

### Environmental Levels

#### Air

- The concentration of barium in ambient air is estimated to be <0.05 µg/m<sup>3</sup>.

#### Sediment and Soil

- Barium is found in most soils at concentrations ranging from about 15 to 3,500 parts per million (ppm) and mean values ranging between 265 and 835 ppm, depending on soil type.

#### Water

- Barium has been found in almost all raw surface waters and public drinking water supplies sampled at concentrations ranging from ≤5 to 15,000 µg/L with mean concentrations generally on the order of 10–60 µg/L.

### Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Toxicological Profile for Barium and Barium Compounds (Draft for Public Comment). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services.

# ToxGuide™ for Barium and Barium Compounds Ba

CAS# 7440-39-3

September 2005

U.S. Department of Health and  
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Public Health Service  
Agency for Toxic Substances  
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## Chemical and Physical Information

### Barium is an alkaline earth metal

- Barium is a silvery-white metal that occurs in nature in many different forms called compounds.
- These compounds are solids and do not burn well.
- Barium is sometimes found naturally in drinking water and food.
- Barium decomposes in water, evolving hydrogen gas.
- Barium oxidizes readily in moist air.
- In powdered form, barium reacts violently with air.
- Because of its high reactivity, barium does not exist as the metal in the environment; it exists in a combined state with other elements.
- Barium sulfate is used mostly by the oil and gas industries to make drilling muds (which keep drill bits lubricated).
- Barium sulfate is also used to make paints, bricks, tiles, glass, rubber, and other barium compounds.
- Barium forms useful alloys with aluminum and magnesium, which are used as getters in electronic tubes to remove residual gases.
- Barium is used as a deoxidizer for steel and other metals.

## Routes of Exposure

- Inhalation (breathing) - generally limited to occupational exposure.
- Ingestion (eating or drinking) - Some foods, such as Brazil nuts, seaweed, fish, and certain plants, may contain high amounts of barium. The amount found in food and water usually is not high enough to be a health concern.
- Dermal (skin) contact.

### Barium in the Environment

- Barium is released primarily to the atmosphere as a result of industrial emissions during the mining, refining, and production of barium and barium chemicals; fossil fuel combustion, entrainment of soil, and rock dust into the air.
- The primary source of naturally occurring barium in drinking water results from the leaching and eroding of sedimentary rocks into groundwater.
- The process of drilling for crude oil and natural gas generates waste drilling fluids or muds, which are often disposed of by land farming. Barium may be introduced into soils as the result of land farming these slurried reserve pit wastes.

## Relevance to Public Health (Health Effects)

Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.

### Minimal Risk Levels (MRLs)

#### Inhalation

- No acute-, intermediate-, or chronic-duration inhalation MRLs were derived for barium.

#### Oral

- An MRL of 0.7 mg barium/kg/day has been derived for intermediate-duration oral exposure (15-364 days).
- An MRL of 0.6 mg barium/kg/day has been derived for chronic-duration oral exposure ( $\geq 365$  days).

### Health Effects (soluble barium compounds)

#### Inhalation

- Baritosis (a rare, benign pneumoconiosis) at high levels can result from inhaled barium particulate matter—generally asymptomatic.
- Difficulty breathing.

#### Oral

- Cardiovascular changes (rate, pressure), gastrointestinal irritation, muscle weakness, kidney effects, and serum potassium level changes.

### Children's Health

- Exposures of children to barium are expected to occur **mainly** from the diet or by dermal contact with barium-containing dust, with minor exposures through barium in air.