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 general population may be exposed to chromium daily through food, drinking water, and air.
- The predominant route of exposure for the general population is ingestion of chromium in the diet.
- Exposure may also occur through inhalation of contaminated air and consumption of contaminated water.
- Chromium(III) is an essential nutrient required for normal energy metabolism.
- The Institute of Medicine of the National Academy of Sciences determined an adequate intake of chromium(III) of 20–45 µg/day for adolescents and adults.

Occupational Populations

- Workers in approximately 80 industries may be exposed to chromium(VI).
- Occupational exposure to chromium primarily occurs from chromate production, stainless steel production and welding, chromium plating, ferrochrome alloys, and chrome pigment production. Workers in the tanning industries are also potentially exposed to chromium.

Toxicokinetics and Normal Human Levels

Toxicokinetics

- The toxicokinetics of a given chromium compound depend on the valence state of the chromium atom and its solubility.
- Chromium is absorbed through the lungs; less-water soluble compounds have a longer retention time in the lung than more soluble forms.
- Less than 10% of an ingested chromium dose is absorbed from the gastrointestinal tract. More soluble compounds have higher absorption fractions.
- Chromium can penetrate human skin to some extent, especially if the skin is damaged.
- Absorbed chromium is distributed to nearly all tissues, with the highest concentrations found in kidneys and liver. Bone is also a major depot and may contribute to long-term retention.
- Chromium(VI) is reduced to chromium(III) via the intermediate forms of chromium(V) and chromium(IV).
- Absorbed chromium is predominantly excreted in the urine.

Normal Human Levels

- In the general population, the mean levels of chromium in serum and urine are 0.10–0.16 and 0.22 µg/L, respectively.

Biomarkers/Environmental Levels

Biomarkers

- Chromium(III) is an essential element and is normally present in blood and urine.
- Exposure to higher than normal levels of chromium may result in increased chromium levels in blood, urine, expired air, hair, and nails.
- Elevations in chromium in blood and urine are considered the most reliable biomarkers of exposure.

Environmental Levels

Air

- Median concentrations in ambient air are <20 ng/m^3.
- Indoor air in areas with cigarette smoking can be 10–400 times higher than outdoor air.

Sediment and Soil

- The mean concentration of chromium in soil is 37.0 mg/kg.

Water

- Most drinking water supplies in the United States contain <5 µg/L of chromium.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2012. Toxicological Profile for Chromium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services.

ToxGuide™ for Chromium

Cr

CAS# 7440-47-3

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U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
www.atsdr.cdc.gov

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ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Chemical and Physical Information

Chromium is a Metal

- Chromium is a naturally occurring element found in rocks, animals, plants, and soil, where it exists in combination with other elements to form various compounds.
- The main forms of chromium are: chromium(0), chromium(III), and chromium(VI).
- Chromium is widely used in manufacturing processes to make various metal alloys such as stainless steel.
- Chromium can be found in many consumer products such as: wood treated with copper dichromate, leather tanned with chromic sulfate, stainless steel cookware, and metal-on-metal hip replacements.

Routes of Exposure

- Inhalation – Predominant route of exposure for occupational populations.
- Oral – Predominant route of exposure for the general population.
- Dermal – Minor route of exposure for the general population.

Chromium in the Environment

- Chromium is released into the atmosphere via industrial, commercial, and residential fuel combustion of natural gas, oil, and coal and from emissions from metal industries such as chrome plating and steel production.
- Approximately 1/3 of atmospheric releases are believed to be in the form of chromium(VI).
- Electroplating, leather tanning, and textile industries release large amounts of chromium to surface water.
- Chromium is primarily removed from the atmosphere by fallout and precipitation, the residence time is expected to be <10 days.
- Most of the chromium released in water will be deposited in the sediments.
- Chromium is not believed to biomagnify in the food chain.

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-duration inhalation MRLs (≤14 days) were derived for Cr(III) or Cr(VI).
- Intermediate-duration inhalation MRLs (15–364 days) were derived:
  - $5x10^{-6}$ mg Cr/m^3 for Cr(VI) aerosols and mists
  - $3x10^{-4}$ mg Cr/m^3 for Cr(VI) particulates
  - $5x10^{-3}$ mg Cr/m^3 for insoluble Cr(III) particulates
  - $1x10^{-4}$ mg Cr/m^3 for soluble Cr(III) particulates
- An MRL of $5x10^{-6}$ mg Cr/m^3 has been derived for chronic-duration inhalation exposure to Cr(VI) aerosols and mists of (≥1 year).

Oral

- No acute-duration oral MRL(≤14 days) was derived for Cr(VI).
- An MRL of $5x10^{-3}$ mg Cr/kg/day has been derived for intermediate-duration oral exposure to Cr(VI) (15–364 days).
- An MRL of $9x10^{-4}$ mg Cr/kg/day has been derived for chronic-duration oral exposure to Cr(VI) (≥1 year).
- No acute-, intermediate-, or chronic duration oral MRLs were derived for Cr(III).

Health Effects

- In general, chromium(VI) compounds are more toxic than chromium(III) compounds.
- The most sensitive targets of chromium(VI) are the respiratory (nasal and lung irritation and altered pulmonary function following inhalation exposure), gastrointestinal (irritation, ulceration, and stomach and small intestine lesions following oral exposure), hematological (microcytic, hypochromic anemia), and reproductive (decreased sperm count and epididymal damage) systems.
- The primary targets of chromium(III) compounds are the respiratory (following inhalation exposure) and immunological systems. Chromium allergic dermatitis is typically elicited by dermal contact in sensitized individuals.
- DHHS, IARC, and EPA have classified chromium(VI) as a human carcinogen.
- IARC has classified chromium(III) and metallic chromium as not classifiable as to their carcinogenicity to humans.

Children's Health

- It is unknown whether children are more sensitive to chromium poisoning than adults.
- In laboratory animals, chromium(VI) causes miscarriages, low birth weight, and changes in development of skeleton and reproductive system. These developmental effects may be related, in part, to maternal chromium toxicity.