

# Iodine

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## Recognizing Iodine

**Appearance:** Laboratory grade elemental iodine appears as either a fine, dark powder or as grayish-black to purple crystals that have a metallic luster. At room temperature iodine crystals readily vaporize to a violet-colored gas (Figure 1).

**Odor:** Characteristically strong, sharp, biting, irritating odor.

**Note:** Odor is *not* a good indicator of the presence of iodine vapors and does not provide reliable warning of hazardous concentrations which occur at levels below odor detection.

**Odor Threshold:** 0.8 ppm (8 mg/m<sup>3</sup>)

**Odor Safety Class:** D (only 10-50% of attentive persons can detect the threshold limit value concentration in air).

**Vapor Density:** 8.8 (air = 1.0); iodine vapor is heavier than air, and it may concentrate near the ground or in depressions.

## Containers & Packaging

**Commercial Products:** Pure iodine crystals in brown glass bottles can be obtained from chemical supply houses.

Veterinary iodine solutions, used as antiseptics, are packaged in opaque plastic bottles. Iodine may be obtained by mild heating of its salts (e.g. sodium iodide or potassium iodide). Iodine crystals may also be obtained from iodine solutions by the addition of 30% hydrogen peroxide.

**Pharmaceutical Iodine Solutions:** These are typically dilute solutions that are brown in color. **Official USP Tincture** is a topical antiseptic solution made up of 2% iodine and 2.4% sodium iodide in 50% ethanol. **Lugol's Solution** is stronger, made up of 5% iodine and 10% potassium iodide in water.



**Figure 1:** Pure iodine crystals, heated slightly, showing some solid iodine escaping directly to the air as obvious violet-colored vapors. Because of this "sublimation" property, exposures include dermal contact with solid crystals and inhalation of vapors which may not be quite as visible as this at room temperature. *Photographer, Charles Salocks.*

## Health Hazards

**Inhalation Exposure:** Iodine vapor causes eye, skin, nose and throat irritation, coughing, wheezing, and laryngitis. Exposure to high concentrations may result in airway spasm, chest tightness, breathing difficulty, severe inflammation, and fluid accumulation in the voice box, upper airways, and lungs. Some people develop allergic hypersensitivity to iodine vapor.

**Ingestion (Oral) Exposure:** Iodine crystals, powder, and concentrated solutions can cause burns in the mouth and throat. Ingestion may cause vomiting, abdominal pain, and diarrhea. Severe poisoning may result in headache, delirium, or a drop in blood pressure. Ingestion of 2-4 grams of solid iodine can be fatal for an average adult.

**Skin (Dermal) Contact:** Burns, irritation, tissue damage, and skin rash result from contact with concentrated iodine. Dilute antiseptic solutions are low in toxicity, but in some cases contact results in a sensitization reaction that includes fever, skin eruptions, and rash. Iodine can be absorbed slightly through the skin and enter the blood.

**Eye Contact:** Concentrated iodine vapor causes brown staining and cornea cell damage. The threshold for eye irritation is about 0.2 ppm (2 mg/m<sup>3</sup>), which is much lower than the odor detection threshold. Dilute iodine solutions produce pain, inflammation, and can damage tissues.

**Chronic Effects:** Effects of long-term exposure to iodine vapor in humans are not known. Iodide is an essential micronutrient in the diet. It is required in small amounts for normal function of the thyroid gland. In laboratory animals, long-term inhalation of iodine vapors disrupts thyroid function and

reduces the ability of the lungs to take up oxygen. Chronic ingestion of amounts that exceed dietary requirements causes health problems such as dietary *iodism* and *goiter*.

## Role in Drug Synthesis

Iodine is used to make hydriodic acid (HI) in the Red Phosphorus/HI methamphetamine synthesis method.

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## Environmental Concerns

**Air:** No information found.

**Soil:** No information found.

**Ground Water:** Contamination of ground water by iodine is unlikely since iodine ( $I_2$ ) is rapidly converted to iodide ( $I^-$ ) in the presence of organic materials. Iodide has low toxicity and, in small quantities, is an essential constituent in the human diet.

**Surface Water:** Naturally occurring background concentrations of iodine detected in surface waters range from 4 to 336  $\mu\text{g/liter}$ . Iodine is hydrolyzed to iodate ( $IO_3^-$ ) and reduced to iodide ( $I^-$ ) ions in water. Iodine in drinking water contributes a small amount of the total daily intake. The recommended daily intake is 150  $\mu\text{g}$ . Iodine toxicity is unlikely to result from drinking water unless the water source is highly contaminated. Studies of iodine's toxicity to non-mammalian species were not identified. The Suggested No Adverse Response Level (SNARL) for iodide ( $I^-$ ) in drinking water is 1.2 ppm (1.2  $\text{mg/liter}$ ).

**Indoors:** Long-term contamination of indoor surfaces is not expected. Elemental iodine has a vapor pressure of 0.3 mm Hg at 25° C and readily volatilizes at room temperature. If present on indoor surfaces, iodine will be removed through volatilization. Inhalation exposure could occur under these circumstances. No standards for cleanup of indoor surface iodine contamination were identified.

## Exposure Limits

**Occupational Exposure Limits (NIOSH, OSHA, & ACGIH)**

Ceiling Limit: 0.1 ppm (1  $\text{mg/m}^3$ )

Immediately Dangerous (IDLH): 2 ppm (21  $\text{mg/m}^3$ )

**Preliminary Remediation Goals (PRGs), (U.S. EPA, Reg 9):**

Air, Soil & Water: not available

## Handling & Safety



## First Aid

**Inhalation Exposure:** Move to fresh air. Administer oxygen if needed. If breathing difficulty occurs, get medical attention.

**Contact with Clothing or Skin:** Remove contaminated clothing. Flush exposed skin and hair with water for at least 5 minutes, and thoroughly wash when possible. Seek medical help if needed.

**Contact with Eyes:** Flush eyes with water or saline solution for at least 15 minutes. Remove contact lenses if easily removable. Seek medical help immediately.

**Ingestion Exposure:** Do not induce vomiting and do not administer activated charcoal. Do not perform gastric lavage and do not attempt neutralization. If victim is conscious, rinse mouth with water. Seek immediate medical attention.

**Special Concerns for Children:** Children may inhale relatively larger amounts of iodine vapors due to their larger lung size to body weight ratio and increased respiratory rates.

Children and others of short stature may receive higher doses, because iodine vapors are heavier than air and may concentrate near the ground in their breathing zone.

## Chemical Hazards

**Reactivity:** Iodine is an oxidizer and is highly reactive.

**Flammability:** Iodine is not flammable. However, it is a strong oxidizer and supports combustion vigorously.

**Chemical Incompatibilities:** Iodine is incompatible with aqueous and gaseous ammonia, powdered aluminum, and active metals such as lithium, sodium, and potassium. Violent explosions may occur when mixed with acetaldehyde or acetylene gas. Large quantities of iodine may react with antimony, producing heat, flame, and explosion.

## More Information

Office of Environmental Health  
Hazard Assessment (OEHHA)  
[www.OEHHA.CA.Gov](http://www.OEHHA.CA.Gov)

Department of Toxic  
Substances Control (DTSC)  
[www.DTSC.CA.Gov](http://www.DTSC.CA.Gov)