

Sodium Cyanide

UN 3414; Sodium cyanide solution

UN 1689; Sodium cyanide, solid or solution

IMO 6.1; Sodium cyanide, solid; Sodium cyanide solution

CAS Registry number: 143-33-9

Reference Source of Information: WISER database (HHS/NIH, National Library of Medicine)

Protective equipment:

Where skin can be exposed ... Protective clothing, including impervious hand protection should be provided. ... /cyanides/

Wear special protective clothing and positive pressure self-contained breathing apparatus.

Respirator Selection: Less than or equal to 25 mg/cu m: (1) Filter type respirators, approved for toxic dust, with half-mask (not applicable for calcium cyanide). (2) Chemical cartridge respirators with replaceable cartridge for toxic dusts and acid gases; With half-mask. Maximum service life 4 hr. Less than or equal to 50 mg/cu m: (1) Full-face gas mask, chest or back mounted type, with industrial size canister for toxic dust and hydrocyanic acid gas. Maximum service life 2 hr. (2) Type C supplied air-respirator, continuous-flow or pressure-demand type (positive pressure) with full facepiece. (3) Type A supplied-air respirator, (hose mask with blower) with full facepiece. Greater than 50 mg/cu m: (1) Self-contained breathing apparatus with positive pressure in full facepiece. (2) Combination supplied-air respirator pressure-demand type with auxiliary self-contained air supply. Emergency (no concentration limit): (1) Self-contained breathing apparatus with positive pressure in facepiece. (2) Combination supplied-air respirator, pressure-demand type, with auxiliary self-contained air supply. Evacuation or Escape (no concentration limit): (1) Self-contained breathing apparatus in demand or pressure-demand mode (negative or positive pressure). (2) Full-face gas mask, front or back mount type with industrial size canister for toxic dust and hydrocyanic acid gas. /Cyanide salts/

Chemical safety goggles shall be worn by employees engaged in any operation wherein there is danger or likelihood that dusts or solutions of cyanide salts will come into contact with the eye. Full-length face shields with forehead protection shall be worn by employees engaged in any operation wherein there is danger or likelihood that dusts, molten salts, or solutions of cyanide salts may contact the face. /Cyanide salts/

... Rubber gloves /should be worn/ when handling cyanide solutions ...

Wear appropriate personal protective clothing to prevent skin contact.

Wear appropriate eye protection to prevent eye contact.

Eyewash fountains should be provided in areas where there is any possibility that workers could be exposed to the substance; this is irrespective of the recommendation involving the wearing of eye protection.

Facilities for quickly drenching the body should be provided within the immediate work area for emergency use where there is a possibility of exposure. [Note: It is intended that these facilities provide a sufficient quantity or flow of water to quickly remove the substance from any body areas likely to be exposed. The actual determination of what constitutes an adequate quick drench facility depends on the specific circumstances. In certain instances, a deluge shower should be readily available, whereas in others, the availability of water from a sink or hose could be considered adequate.]

Recommendations for respirator selection. Max concn for use: 25 mg/cu m. Respirator Class(es): Any supplied-air respirator. Any self-contained breathing apparatus with a full facepiece.

Recommendations for respirator selection. Condition: Emergency or planned entry into unknown concn or IDLH conditions: Respirator Class(es): Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive pressure mode. Any supplied-air respirator that has a full face piece and is operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.

Recommendations for respirator selection. Condition: Escape from suddenly occurring respiratory hazards: Respirator Class(es): Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister /SRP: rebreather or oxygen generating/ providing protection against the compound of concern and having a high-efficiency particulate filter. Any appropriate escape-type, self-contained breathing apparatus.

HEALTH Effects

0.2.1 SUMMARY OF EXPOSURE

- 0.2.1.1 ACUTE EXPOSURE
 - A) Sodium cyanide exposure may produce death within minutes. Signs and symptoms following non-lethal, subacute, or chronic exposure may include syncope, weight loss, headache, dizziness, nausea, vomiting, palpitations, confusion, deep inspiratory gasps followed by hyperpnea, hyperventilation, anxiety, and vertigo.
 - B) Cyanosis is generally a late finding and usually does not occur until circulatory collapse and apnea are evident; particularly at the premorbid stage of cyanide toxicity. Initially the patient may experience flushing, tachycardia, tachypnea, headache, and dizziness. This may progress to agitation, stupor, coma, apnea, seizures, metabolic acidosis, pulmonary edema, bradycardia, hypotension, and death.
 - C) Sodium cyanide exposure may produce death within minutes. IMMEDIATELY BEGIN ADMINISTERING 100% OXYGEN. OBTAIN THE CYANIDE ANTIDOTE KIT AND PREPARE IT FOR USE. Non-lethal, subacute, or chronic exposure may produce headache, dizziness, nausea, vomiting, palpitations, confusion, deep inspiratory gasps followed by hyperpnea, hyperventilation, anxiety, and vertigo. Severe signs of hypoxia in the absence of cyanosis suggest cyanide poisoning. Patients have reportedly survived potentially lethal ingestions with only supportive care. The absence of a rapidly deteriorating course does not exclude cyanide poisoning.
- 0.2.1.2 CHRONIC EXPOSURE
 - A) Functional changes in hearing, loss of appetite, headache, weakness, nausea, dizziness, upper respiratory tract irritation, and dermatoses have been described in chronically exposed workers.

0.2.3 VITAL SIGNS

- 0.2.3.1 ACUTE EXPOSURE
 - A) Tachycardia, deep inspiratory gasps followed by hyperpnea, tachypnea, hypertension may be early findings after acute cyanide poisoning, followed by hypotension, bradycardia, dyspnea, apnea, and asystole.
 - 1) Tachycardia and hypertension may be seen in the initial phases of cyanide poisoning (Vogel et al, 1981).
 - 2) Bradycardia and hypotension are seen in the late phases of cyanide poisoning (Stewart, 1974; Hall & Rumack, 1986).

0.2.4 HEENT

- 0.2.4.1 ACUTE EXPOSURE
 - A) Dilated pupils are common in severe poisoning; corneal edema, conjunctivitis, and keratitis may occur. Retinal arteries and veins may appear equally red on fundoscopic examination.
 - B) Transient blindness has been reported in rare instances. Damaged optic nerves have been observed in experimental animals. A burning sensation in the nose, mouth, and throat may occur.

0.2.5 CARDIOVASCULAR

- 0.2.5.1 ACUTE EXPOSURE
 - A) Tachycardia, bradycardia, hypertension, hypotension, cardiac dysrhythmias, EKG changes, and asystole may be observed.

0.2.6 RESPIRATORY

- 0.2.6.1 ACUTE EXPOSURE
 - A) Tachypnea, deep inspiratory gasps followed by hyperpnea, apnea, noncardiogenic pulmonary edema may be apparent.

0.2.7 NEUROLOGIC

- 0.2.7.1 ACUTE EXPOSURE
 - A) Symptoms following acute cyanide exposure include syncope, headache or CNS stimulation, agitation, dizziness, and vertigo followed by coma, seizures, and death. Sequelae may be paralysis and a Parkinsonian syndrome.

0.2.8 GASTROINTESTINAL

- 0.2.8.1 ACUTE EXPOSURE
 - A) Nausea, vomiting, and abdominal pain may occur.

0.2.11 ACID-BASE

- 0.2.11.1 ACUTE EXPOSURE
 - A) Anion gap metabolic acidosis and lactic acidosis are evident following cyanide toxicity.

0.2.13 HEMATOLOGIC

- 0.2.13.1 ACUTE EXPOSURE
 - A) Venous blood may have a bright red color. Anemia has also been reported.

0.2.14 DERMATOLOGIC

- 0.2.14.1 ACUTE EXPOSURE
 - A) Cyanide has been said to be absorbed through intact skin. Itching, irritation, rash, and dermatitis may occur.
 - B) Cyanosis may be evident particularly at the premorbid stage of cyanide toxicity.

0.2.15 MUSCULOSKELETAL

- 0.2.15.2 CHRONIC EXPOSURE
 - A) Permanent motor impairment may occur.

0.2.16 ENDOCRINE

0.2.16.1 ACUTE EXPOSURE

- A) Enlarged thyroid glands may occur. Thyroid dysfunction has been reported from chronic occupational exposure to cyanide.

0.2.18 PSYCHIATRIC

- 0.2.18.2 CHRONIC EXPOSURE
 - A) Permanent mental impairment may occur following severe acute poisoning.

0.2.20 REPRODUCTIVE HAZARDS

- A) ANIMAL STUDIES - Sodium cyanide administered to pregnant rats has produced an increased incidence of resorptions and congenital malformations in the offspring, consisting of neural tube defects including exencephaly and encephalocele (Doherty et al, 1982). Concomitant administration of sodium thiosulfate prevented these teratogenic effects (Doherty et al, 1982). Post-implantation mortality was observed in the hamster.
- B) At the time of this review, no data were available to assess the potential effects of exposure to this agent during lactation.
- C) No information about possible male reproductive effects was found in available references at the time of this review.

0.2.21 CARCINOGENICITY

- 0.2.21.1 IARC CATEGORY
 - A) IARC Carcinogenicity Ratings for CAS143-33-9 (IARC, 2004):
 - 1) Not Listed
- 0.2.21.2 HUMAN OVERVIEW
 - A) At the time of this review, no studies were found on the possible carcinogenic activity of sodium cyanide in humans.
- 0.2.21.3 ANIMAL OVERVIEW
 - A) At the time of this review, no studies were found on the possible carcinogenic activity of sodium cyanide in experimental animals.

0.2.22 GENOTOXICITY

- A) Sodium cyanide caused sex chromosome loss/nondisjunction in *D. melanogaster*.

0.2.23 OTHER

- 0.2.23.1 ACUTE EXPOSURE
 - A) The odor of bitter almonds in expired breath or gastric contents of patients may not be detected by a significant portion of the population.

Health issues / recommended Treatments

0.4.2 ORAL EXPOSURE

- A) EMERGENCY MEASURES - In SYMPTOMATIC patients advance life support including use of the cyanide antidote KIT should be initiated as gastrointestinal decontamination is being prepared.
- B) EMESIS: Ipecac-induced emesis is not recommended because of the potential for CNS depression and seizures.
- C) ACTIVATED CHARCOAL: Administer charcoal as a slurry (240 mL water/30 g charcoal). Usual dose: 25 to 100 g in adults/adolescents, 25 to 50 g in children (1 to 12 years), and 1 g/kg in infants less than 1 year old.

- D) GASTRIC LAVAGE: Consider after ingestion of a potentially life-threatening amount of poison if it can be performed soon after ingestion (generally within 1 hour). Protect airway by placement in Trendelenburg and left lateral decubitus position or by endotracheal intubation. Control any seizures first.
 - 1) CONTRAINDICATIONS: Loss of airway protective reflexes or decreased level of consciousness in unintubated patients; following ingestion of corrosives; hydrocarbons (high aspiration potential); patients at risk of hemorrhage or gastrointestinal perforation; and trivial or non-toxic ingestion.
- E) OXYGEN - Immediately begin therapy with 100% oxygen. Oxygen may reverse the cyanide-cytochrome oxidase complex. Obtain and prepare for administration the cyanide antidote kit to the symptomatic patient.
- F) IV ACCESS - Establish two secure large bore IV lines in symptomatic patients.
- G) A cyanide antidote, either hydroxocobalamin or the sodium nitrite/sodium thiosulfate kit, should be administered to patients with symptomatic poisoning.
- H) HYDROXOCOBALAMIN: ADULT DOSE: 5 g (two 2.5 g vials each reconstituted with 100 mL sterile 0.9% saline) administered as an intravenous infusion over 15 minutes. For severe poisoning, a second dose of 5 g may be infused intravenously over 15 minutes to 2 hours, depending on the patient's condition. CHILDREN: Limited experience; a dose of 70 mg/kg has been used in pediatric patients.
- I) CYANIDE ANTIDOTE KIT - If cyanide poisoning is suspected, amyl nitrite inhalant should be held close to the patient's nose or mouth for 30 seconds of each minute until the IV site has been established and sodium nitrite dose is available.
 - 1) SODIUM NITRITE - ADULT DOSE 300 mg (10 mL IV over 5 minutes). CHILD (with normal hemoglobin): 0.15 to 0.33 mL/kg up to 10 mL over 5 minutes IV.
 - 2) Sodium nitrite should be followed by: SODIUM THIOSULFATE. ADULT DOSE is 12.5 grams IV. Usual pediatric dose is 1.65 mL/kg of 25% solution.
- J) HYPOTENSION: Infuse 10 to 20 mL/kg isotonic fluid. If hypotension persists, administer dopamine (5 to 20 mcg/kg/min) or norepinephrine (ADULT: begin infusion at 0.5 to 1 mcg/min; CHILD: begin infusion at 0.1 mcg/kg/min); titrate to desired response.
- K) ACIDOSIS - Administer sodium bicarbonate, 1 milliequivalent/kilogram intravenously to severely acidotic patients (pH < 7.1). Base further sodium bicarbonate administration on serial arterial blood gas determinations.
 - 1) Acidosis may be difficult to correct prior to administration of antidotes in serious cyanide poisoning cases.
- L) SEIZURES: Administer a benzodiazepine IV; DIAZEPAM (ADULT: 5 to 10 mg, repeat every 10 to 15 min as needed. CHILD: 0.2 to 0.5 mg/kg, repeat every 5 min as needed) or LORAZEPAM (ADULT: 2 to 4 mg; CHILD: 0.05 to 0.1 mg/kg).
 - 1) Consider phenobarbital or propofol if seizures recur after diazepam 30 mg (adults) or 10 mg (children > 5 years).
 - 2) Monitor for hypotension, dysrhythmias, respiratory depression, and need for endotracheal intubation. Evaluate for hypoglycemia, electrolyte disturbances, hypoxia.
- M) METHEMOGLOBINEMIA - Methylene or toluidine blue treatment may be considered if symptomatic methemoglobinemia is evident from excessive nitrite administration. Consider exchange transfusion for severe symptomatic methemoglobinemia.
- N) HYPERBARIC OXYGEN AND HEMODIALYSIS - May be useful adjunct treatments in severe cases not responsive to supportive and conventional antidotal therapy.
- O) ACUTE LUNG INJURY: Maintain ventilation and oxygenation and evaluate with frequent arterial blood gas or pulse oximetry monitoring. Early use of PEEP and mechanical ventilation may be needed.
- P) ALTERNATE ANTIDOTES - Kelocyanor
- (R) (dicobalt-EDTA) and 4-DMAP (4-dimethylaminophenol) are among the cyanide antidotes in clinical use outside the US. SEE TREATMENT SELECTION in the main body of this document for more information.

0.4.3 INHALATION EXPOSURE

- A) INHALATION: Move patient to fresh air. Monitor for respiratory distress. If cough or difficulty breathing develops, evaluate for respiratory tract irritation, bronchitis, or

pneumonitis. Administer oxygen and assist ventilation as required. Treat bronchospasm with inhaled beta2 agonist and oral or parenteral corticosteroids.

- B) Administer 100% oxygen. Establish and secure vascular accesses.

0.4.4 EYE EXPOSURE

- A) DECONTAMINATION: Irrigate exposed eyes with copious amounts of room temperature water for at least 15 minutes. If irritation, pain, swelling, lacrimation, or photophobia persist, the patient should be seen in a health care facility.
- B) Experimental animals have developed serious systemic cyanide poisoning following ocular exposure. Human poisoning cases have not been reported due to eye exposure only.

0.4.5 DERMAL EXPOSURE

- A) OVERVIEW
 - 1) DECONTAMINATION: Remove contaminated clothing and wash exposed area thoroughly with soap and water. A physician may need to examine the area if irritation or pain persists.
 - 2) While cyanide can be absorbed through intact skin, most reported cases have involved whole-body immersion in cyanide solutions or large-area burns with molten cyanide solutions. Most nitrile compounds are well absorbed through intact skin, and may cause delayed onset of symptoms following exposure by this route.
 - 3) Administer 100% oxygen, establish and secure vascular accesses.