

Heptachlor (C₁₀H₅Cl₇)
CAS 76-44-8; UN 2761
Heptachlor Epoxide (C₁₀H₅Cl₇O)
CAS 1024-57-3; UN 2761

Synonyms for heptachlor include 3-chlorochlordene; 1,4,5,6,7,8,8a-heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene; Heptagran, Heptamul; Velsicol 104.

Synonyms for heptachlor epoxide include epoxiheptachlor; 1,4,5,6,7,8,8a-heptachloro-2,3-epoxy-3a,4,7,7a-tetrahydro-4,7-methanoindene; Velsicol 53-CS-17.

- **Persons exposed to heptachlor or heptachlor epoxide via the inhalation exposure route do not pose secondary contamination risks. Persons whose clothing or skin is contaminated with heptachlor or its epoxide can secondarily contaminate others by direct contact.**
- **At room temperature, heptachlor is a white or tan solid with a camphor-like odor. Heptachlor and its epoxide are nonflammable, but may be dissolved in flammable liquids. Heptachlor reacts with iron and rust to form hydrogen chloride gas.**
- **Heptachlor and its epoxide are toxic by all exposure routes.**

Description

Heptachlor is a white or tan crystalline (pure) or waxy (technical grade) solid with a camphor-like odor. Heptachlor epoxide is formed by biological and chemical transformation of heptachlor in the environment. Heptachlor is noncombustible, but may be dissolved in flammable liquids. Heptachlor is slightly more water soluble than heptachlor epoxide, although both are relatively insoluble in water. Heptachlor and its epoxide are both soluble in most organic solvents (ACGIH 2001; ATSDR 2005).

Routes of Exposure

Inhalation

Heptachlor is readily absorbed from the lung (ATSDR 2005; IPCS 2000).

Children exposed to the same levels of airborne heptachlor as adults may receive a larger dose because they have greater lung surface area:body weight ratios and higher minute volumes:weight ratios. In addition, they may be exposed to higher levels than adults in the same location because of their short stature and the higher levels of heptachlor found nearer to the ground.

Skin/Eye Contact

Heptachlor is readily absorbed through the skin following dermal exposure (ATSDR 2005; IPCS 2000).

Because of their relatively larger surface area:body weight ratio, children are more vulnerable to toxicants absorbed through the skin.

Ingestion

Ingested heptachlor and its epoxide are readily absorbed from the gastrointestinal tract (ATSDR 2005; IPCS 2000).

Sources/Uses

Heptachlor is produced commercially by the free-radical chlorination of chlordene in benzene containing from 0.5 to 5.0% of Fuller's earth. Bacteria and animals break down heptachlor to form heptachlor epoxide, which is not manufactured and was not used as an insecticide like heptachlor (ATSDR 2005).

Heptachlor may be used to control fire ants in power transformers; all formerly approved uses as an insecticide in homes, buildings, and food crops in the United States have been cancelled (ATSDR 2005).

Standards and Guidelines

OSHA PEL (permissible exposure limit) = 0.5 mg/m³ as an 8-hour TWA concentration (OSHA 1999).

NIOSH IDLH (immediately dangerous to life or health) = 35 mg/m³; notation of potential for cancer (NIOSH 2005).

Physical Properties

Heptachlor

Description: White or tan crystalline (pure) or waxy (technical grade) solid (ATSDR 2005; HSDB 2007).

Warning properties: Camphor-like odor with a detection limit of 0.3 mg/m³ (0.02 ppm) (ATSDR 2005; HSDB 2007)

Molecular weight: 373.32 (Budavari 2001)

Boiling point: 145 EC (293 EF) (ATSDR 2005)

Freezing point: 95–96 EC (203–205 EF) (Budavari 2001)

Vapor pressure: 0.0003 mm Hg at 25 EC (77 EF) (Budavari 2001)

Density: 1.57–1.59 g/mL (Verschueren 2001)

Water solubility: 0.05 mg/L at 25 EC (ATSDR 2005)

Flammability: Nonflammable, but may be dissolved in flammable liquids (ATSDR 2005; HSDB 2007)

Heptachlor epoxide

Description: White crystalline solid (ATSDR 2005)

Molecular weight: 389.40 (ATSDR 2005)

Water solubility: 0.275 mg/L at 25 EC (ATSDR 2005)

Incompatibilities

Heptachlor reacts with strong oxidants and attacks metals (IPCS 2000). Heptachlor reacts with iron and rust to form hydrogen chloride gas (HSDB 2007).

Health Effects

- **Extensive dermal contact with organochlorine pesticides such as heptachlor may result in dermal irritation, although heptachlor-specific data were not located.**
- **Heptachlor has been shown to adversely affect the CNS, liver, and developing nervous and immunological systems in animals.**
- **Cyclodiene-type insecticides, such as heptachlor, block the uptake of chloride ions by nerve cells, which results in uncontrolled excitation. Heptachlor may suppress cellular respiration.**

Acute Exposure

Extremely limited data are available regarding heptachlor-induced health effects in humans. However, cyclodiene-type insecticides such as heptachlor block the uptake of chloride ions by nerve cells, which results in only partial repolarization of the neuron and a state of uncontrolled excitation (ATSDR 2005; HSDB 2007). Heptachlor appears to suppress cellular respiration by interfering with the electron transport system (HSDB 2007).

Children do not always respond to chemicals in the same manner as adults. Different protocols for managing their care may be needed.

Dermal

The potential for heptachlor and heptachlor epoxide to produce dermal irritation has not been assessed in available literature. However, extensive dermal contact with organochlorine pesticides in general may result in dermal irritation (HSDB 2007).

Because of their relatively larger surface area:body weight ratio, children are more vulnerable to toxicants affecting the skin.

CNS

Serious heptachlor or heptachlor epoxide poisoning may cause such CNS effects as convulsions, seizures, and hyperexcitability. Seizures may appear as late as 48 hours after exposure and recur over several days (ATSDR 2005; HSDB 2007; IPCS 2000).

<i>Hepatic</i>	Liver damage has been demonstrated in animals following short-term exposure to heptachlor (ATSDR 2005).
<i>Immunologic</i>	<p>Heptachlor caused damage to the developing immunological system of animals (ATSDR 2005).</p> <p>The immune system in children continues to develop after birth, and thus children may be more susceptible to certain chemicals.</p>
<i>Potential Sequelae</i>	Serious heptachlor or heptachlor epoxide poisoning could potentially result in long-term effects on the liver and CNS.
Chronic Exposure	Human data are lacking regarding potential health effects specifically associated with chronic exposure to heptachlor or heptachlor epoxide.
<i>Carcinogenicity</i>	The EPA (IRIS 2007) and International Agency for Research on Cancer (IARC 2001) have classified heptachlor as a possible human carcinogen, based on findings of increased incidences of liver tumors in mice fed heptachlor for a lifetime. The EPA also considers heptachlor epoxide to be a possible human carcinogen.
<i>Reproductive and Developmental Effects</i>	No studies were located that address reproductive or developmental effects of heptachlor or its epoxide in humans. Heptachlor caused adverse reproductive and developmental (neurological and immunological) effects when given to animals (ATSDR 2005).

Prehospital Management

- **Victims whose clothing or skin is contaminated with heptachlor or heptachlor epoxide can secondarily contaminate response personnel by direct contact.**
- **There is no antidote for heptachlor or heptachlor epoxide. Treatment consists of respiratory and cardiovascular support and seizure control.**

Hot Zone

Rescuers should be trained and appropriately attired before entering the Hot Zone. If the proper equipment is not available, or if rescuers have not been trained in its use, assistance should be obtained from a local or regional HAZMAT team or other properly equipped response organization.

Rescuer Protection

Heptachlor is toxic via all routes of exposure. Heptachlor is nonflammable, but may be dissolved in flammable liquids. Heptachlor decomposes at temperatures above 160 EC, producing toxic gases such as hydrogen chloride (IPCS 2000).

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is recommended in response situations that involve exposure to potentially unsafe levels of heptachlor (HSDB 2007).

Skin Protection: Chemical-protective clothing is recommended because heptachlor is readily absorbed through the skin.

ABC Reminders

Quickly establish a patent airway; ensure adequate respiration and pulse. If trauma is suspected, maintain cervical immobilization manually and apply a cervical collar and a backboard when feasible.

Victim Removal

If victims can walk, lead them out of the Hot Zone to the Decontamination Zone. Victims who are unable to walk may be removed on backboards or gurneys; if these are not available, carefully carry or drag victims to safety.

Victims with chemically-induced acute disorders may suffer from anxiety, especially children who may be separated from a parent or other adult.

Decontamination Zone

Patients exposed to heptachlor or heptachlor epoxide via inhalation only may be transferred immediately to the Support Zone. Other patients will require decontamination as described below.

Rescuer Protection

If exposure levels are determined to be safe, decontamination may be conducted by personnel wearing a lower level of protection than that worn in the Hot Zone (described above).

ABC Reminders

Quickly establish a patent airway; ensure adequate respiration and pulse. Stabilize the cervical spine with a collar and a backboard if trauma is suspected. Administer supplemental oxygen as required. Assist ventilation with a bag-valve-mask device if necessary.

Basic Decontamination

Victims who are able may assist with their own decontamination. Quickly remove and double-bag contaminated clothing and personal belongings.

Flush exposed skin and hair with copious amounts of water. Wash with soap and rinse thoroughly with water (HSDB 2007). Use caution to avoid hypothermia when decontaminating victims, particularly children or the elderly. Use blankets or warmers after decontamination as needed.

Flush exposed or irritated eyes with tepid water for 15 minutes. Remove contact lenses if easily removable without additional trauma to the eye. Continue eye irrigation during other basic care and transport. If pain or injury is evident, continue irrigation while transferring the victim to the Support Zone.

In cases of ingestion of a potentially life-threatening amount of heptachlor or its epoxide, gastric lavage may be performed after tracheal intubation by a trained emergency responder, but only if the victim is conscious and the ingestion occurred within 1 hour prior to treatment. Consider administering a laxative such as sodium sulfate. Oil-based cathartics or dermal cleansing agents should not be used because they increase absorption (HSDB 2007; IPCS 2000).

If the victim is symptomatic, delay decontamination until other emergency measures have been instituted.

Provide reassurance to chemically-contaminated victims during decontamination, particularly children who may suffer separation anxiety if separation from a parent occurs.

Transfer to Support Zone

As soon as basic decontamination is complete, move the victim to the Support Zone.

Support Zone

Be certain that victims have been decontaminated properly (see *Decontamination Zone*, above). Victims who have undergone decontamination or have been exposed only to vapor pose no serious risks of secondary contamination to rescuers. In such cases, Support Zone personnel require no specialized protective gear.

ABC Reminders

Quickly establish a patent airway, ensure adequate respiration and pulse. If trauma is suspected, maintain cervical immobilization manually and apply a cervical collar and a backboard when feasible. Administer supplemental oxygen as required and establish intravenous access if necessary. Place on a cardiac monitor.

Additional Decontamination

Continue irrigating exposed skin and eyes, as appropriate.

Advanced Treatment

In cases of respiratory compromise, secure airway and support respiration according to ALS protocols.

Treat patients who have bronchospasm with an aerosolized bronchodilator such as albuterol. Consider the health of the myocardium before choosing which type of bronchodilator should be administered. Consider that heptachlor may cause myocardial irritability (HSDB 2007), in which case the use of bronchodilators that are known cardiac sensitizing agents may pose enhanced risk of cardiac arrhythmias (especially in the elderly).

If evidence of shock or hypotension is observed, begin fluid administration. For adults with systolic pressure less than 80 mm Hg, bolus perfusion of 1,000 mL/hour intravenous saline or lactated Ringer's solution may be appropriate. Higher adult systolic pressures may necessitate lower perfusion rates. For children with compromised perfusion, administer a 20 mL/kg bolus of normal saline over 10–20 minutes, followed by reassessment of perfusion and further management as clinically appropriate.

Patients who are comatose, hypotensive, or have seizures or ventricular arrhythmias should be treated in the conventional manner. When considering drug therapy, note that organochlorines such as heptachlor may induce cardiac irritability (HSDB 2007). Benzodiazepines may be preferred for initial treatment of heptachlor-induced seizures.

Transport to Medical Facility

Only decontaminated patients or patients not requiring decontamination should be transported to a medical facility. "Body bags" are not recommended.

Report to the base station and the receiving medical facility the condition of the patient, treatment given, and estimated time of arrival at the medical facility.

In cases of heptachlor or heptachlor epoxide ingestion, prepare the ambulance in case the victim vomits. Have ready several towels and open plastic bags to quickly clean up and isolate vomitus.

Multi-Casualty Triage

Consult with the base station physician or the regional poison control center for advice regarding triage of multiple victims.

Patients who are seriously symptomatic (as in cases of chest tightness or wheezing), patients who have histories or evidence of significant exposure, and all patients who have ingested heptachlor or its epoxide should be transported to a medical facility for evaluation. Others may be discharged at the scene after their names, addresses, and telephone numbers are recorded. Those discharged should be advised to seek medical care promptly if symptoms develop (see *Patient Information Sheet* below).

Emergency Department Management

- **Hospital personnel in an enclosed area can be secondarily contaminated by direct contact with contaminated skin or clothing. Patients do not pose contamination risks after contaminated clothing is removed and the skin is washed.**
- **There is no antidote for heptachlor or heptachlor epoxide. Treatment consists of respiratory and cardiovascular support and seizure control.**

Decontamination Area

Unless previously decontaminated, all patients suspected of contact with heptachlor or its epoxide and all victims with skin or eye irritation require decontamination as described below. All other patients may be transferred immediately to the Critical Care Area.

Be aware that use of protective equipment by the provider may cause anxiety, particularly in children, resulting in decreased compliance with further management efforts.

Because of their relatively larger surface area:body weight ratio, children are more vulnerable to toxicants that contact the skin. Also emergency department personnel should examine and cleanse children's mouths as needed because of the frequency of hand-to-mouth activity among children.

ABC Reminders

Evaluate and support airway, breathing, and circulation According to ALS protocols.

Treat patients who have bronchospasm with an aerosolized bronchodilator such as albuterol. Consider the health of the myocardium before choosing which type of bronchodilator should be administered. Consider that heptachlor may cause myocardial irritability (HSDB 2007), in which case the use of bronchodilators that are known cardiac sensitizing agents may pose enhanced risk of cardiac arrhythmias (especially in the elderly). Administer corticosteroids as indicated to patients who have persistent wheezing or hypersensitivity pneumonitis.

Patients who are comatose, hypotensive, or have seizures or ventricular arrhythmias should be treated in the conventional manner. When considering drug therapy, note that organochlorines such as heptachlor may induce cardiac irritability (HSDB 2007). Benzodiazepines may be preferred for initial treatment of heptachlor-induced seizures.

Basic Decontamination

Victims who are able may assist with their own decontamination. Quickly remove and double-bag contaminated clothing and all personal belongings.

Flush exposed skin and hair with water with copious amounts of water. Wash with soap and rinse thoroughly with water (HSDB 2007). Use caution to avoid hypothermia when decontaminating victims, particularly children or the elderly. Use blankets or warmers after decontamination as needed.

Flush exposed eyes or irritated eyes with tepid water for 15 minutes (HSDB 2007). Remove contact lenses if easily removable without additional trauma to the eye. If pain or injury is evident, continue irrigation while transporting the patient to the Critical Care Area.

In cases of ingestion of a potentially life-threatening amount of heptachlor or its epoxide, gastric lavage may be performed (if not previously done) after tracheal intubation by a trained emergency responder, but only if the victim is conscious and the ingestion occurred within 1 hour prior to treatment. If the victim is alert, asymptomatic, and has a gag reflex, consider administering a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose) if it has not already been administered. Administer a laxative such as sodium sulfate if it has not already been administered. Oil-based cathartics or dermal cleansing agents should not be used because they increase absorption (HSDB 2007; IPCS 2000). See *Critical Care Area* below for more information on ingestion exposure.

Critical Care Area

Be certain that appropriate decontamination has been carried out (see *Decontamination Area* above).

ABC Reminders

Evaluate and support airway, breathing, and circulation as in ABC Reminders above under *Decontamination Zone*. Establish intravenous access in seriously ill patients if this has not been done previously. Continuously monitor cardiac rhythm.

Patients who are comatose, hypotensive, or have seizures or cardiac arrhythmias should be treated in the conventional manner. When considering drug therapy, note that organochlorines such as heptachlor may induce cardiac irritability (HSDB 2007). Benzodiazepines may be preferred for initial treatment of heptachlor-induced seizures.

Inhalation Exposure

Administer supplemental oxygen by mask to patients who have respiratory symptoms. Treat patients who have bronchospasm with an aerosolized bronchodilator such as albuterol. Consider the health of the myocardium before choosing which type of bronchodilator should be administered. Consider that heptachlor may cause myocardial irritability (HSDB 2007), in which case the use of bronchodilators that are known cardiac sensitizing agents may pose enhanced risk of cardiac arrhythmias (especially in the elderly). Administer corticosteroids as indicated to patients who have persistent wheezing or hypersensitivity pneumonitis.

Eye Exposure

Continue irrigation for at least 15 minutes. Test visual acuity. Examine the eyes for corneal damage and treat appropriately. Immediately consult an ophthalmologist for patients who have corneal injuries.

Ingestion Exposure

If not already performed, and if the victim is alert, asymptomatic, and has a gag reflex, consider administering a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose).

Consider gastric lavage with a small nasogastric (NG) tube if: (1) a large dose has been ingested; (2) the patient's condition is evaluated within 30 minutes; (3) the patient has oral lesions or persistent esophageal discomfort; and (4) the lavage can be administered within 1 hour of ingestion. Care must be taken when placing the gastric tube because blind gastric-tube placement may further injure the chemically damaged esophagus or stomach.

Because of the risk of perforation from NG intubation, lavage is discouraged in children unless performed under endoscopic guidance.

Vomitus or gastric washings should be isolated, e.g., by attaching the lavage tube to isolated wall suction or another closed container.

Antidotes and Other Treatments

There is no antidote for heptachlor or its epoxide. Treatment is supportive of respiratory and cardiovascular functions and seizure control.

Laboratory Tests

Routine laboratory studies for all exposed patients include CBC, glucose, and electrolyte determinations. Patients who have respiratory complaints may require pulse oximetry (or ABG measurements), chest radiography, and/or peak-flow spirometry.

Disposition and Follow-up

Consider hospitalizing patients who have histories of significant inhalation exposure and are symptomatic (e.g., chest tightness or wheezing) or who have ingested heptachlor or its epoxide.

Delayed Effects

Seizures may first appear as long as 48 hours after exposure and recur over several days (IPCS 2000).

Patient Release

Patients who remain asymptomatic for 24 hours after exposure may be discharged with instructions to seek medical care promptly if symptoms develop (see the *Heptachlor—Patient Information Sheet* below).

Follow-up

Obtain the name of the patient's primary care physician so that the hospital can send a copy of the emergency department (ED) visit to the patient's doctor.

If significant inhalation or skin contact has occurred, monitor pulmonary function. In rare cases, individuals may be permanently sensitized and may need to be removed from future work with heptachlor; patients should consult an occupational medicine or pulmonary specialist before returning to work that entails exposure to heptachlor.

Patients who have corneal injuries should be reexamined within 24 hours.

Reporting

If a work-related incident has occurred, you may be legally required to file a report; contact your state or local health department.

Other persons may still be at risk in the setting where this incident occurred. If the incident occurred in the workplace, discussing it with company personnel may prevent future incidents. If a public health risk exists, notify your state or local health department or other responsible public agency. When appropriate, inform patients that they may request an evaluation of their workplace from OSHA or NIOSH. See Appendix III for a list of agencies that may be of assistance.

Heptachlor and Heptachlor Epoxide Patient Information Sheet

This handout provides information and follow-up instructions for persons who have been exposed to heptachlor or heptachlor epoxide.

What are heptachlor and heptachlor epoxide?

Heptachlor is a white or tan crystalline or waxy solid with a camphor-like odor. Heptachlor epoxide is a white crystalline solid. Heptachlor is an insecticide that can be used only for controlling fire ants in power transformers. Heptachlor epoxide is formed by the oxidation of heptachlor in biological systems.

What immediate health effects can be caused by exposure to heptachlor?

The general public is not likely to be exposed to heptachlor at levels high enough to cause adverse health effects. However exposure to relatively high levels of heptachlor could result in effects on the central nervous system (hyperexcitability, convulsions, or seizures) and liver damage. Generally, the more serious the exposure, the more severe the symptoms.

Can heptachlor poisoning be treated?

There is no antidote for heptachlor, but its effects can be treated and most exposed persons get well. Seriously exposed persons may need to be hospitalized.

Are any future health effects likely to occur?

Seizures may appear as long as 48 hours after exposure to heptachlor and may recur over several days. Therefore, it is important to tell your doctor that you have been exposed to heptachlor or heptachlor epoxide. The EPA and International Agency for Research on Cancer (IARC) have classified heptachlor as a possible human carcinogen, based on increased incidences of liver tumors in mice fed heptachlor for a lifetime.

What tests can be done if a person has been exposed to heptachlor or heptachlor epoxide?

Laboratory tests can detect heptachlor and heptachlor epoxide in blood, fat, breast milk, and body tissues after exposure to high levels. Most often, the test for heptachlor epoxide is used because heptachlor is quickly changed into heptachlor epoxide in your body. However, heptachlor is both a breakdown product and a component of chlordane, another pesticide. So if heptachlor and heptachlor epoxide are measured in the blood, the actual exposure could have been to chlordane. A few days after exposure, blood levels of heptachlor and heptachlor epoxide decrease and can no longer be measured. Therefore, blood tests for these chemicals must be done within a short period after exposure. Levels in fat can be measured for a much longer period after exposure.

Where can more information about heptachlor and heptachlor epoxide be found?

More information about heptachlor and heptachlor epoxide can be obtained from your regional poison control center; your state, county, or local health department; the Agency for Toxic Substances and Disease Registry (ATSDR); your doctor; or a clinic in your area that specializes in occupational and environmental health. If the exposure happened at work, you may wish to discuss it with your employer, the Occupational Safety and Health Administration (OSHA), or the National Institute for Occupational Safety and Health (NIOSH). Ask the person who gave you this form for help in locating these telephone numbers.

Follow-up Instructions

Keep this page and take it with you to your next appointment. Follow *only* the instructions checked below.

Call your doctor or the Emergency Department if you develop any unusual signs or symptoms within the next 24 hours, especially:

- hyperexcitability, convulsions, or seizures

No follow-up appointment is necessary unless you develop any of the symptoms listed above.

Call for an appointment with Dr. _____ in the practice of _____.

When you call for your appointment, please say that you were treated in the Emergency Department at _____ Hospital by _____ and were advised to be seen again in _____ days.

Return to the Emergency Department/_____ Clinic on (date) _____ at _____ AM/PM for a follow-up examination.

Do not perform vigorous physical activities for 1–2 days.

You may resume everyday activities including driving and operating machinery.

Do not return to work for ____ days.

You may return to work on a limited basis. See instructions below.

Avoid exposure to cigarette smoke for 72 hours; smoke may worsen the condition of your lungs.

Avoid drinking alcoholic beverages for at least 24 hours; alcohol may worsen injury to your stomach or have other effects.

Avoid taking the following medications: _____

You may continue taking the following medication(s) that your doctor(s) prescribed for you:

Other instructions: _____

- Provide the Emergency Department with the name and the number of your primary care physician so that the ED can send him or her a record of your emergency department visit.

- You or your physician can get more information on the chemical by contacting: _____ or _____, or by checking out the following Internet Web sites: _____; _____.

Signature of patient _____ Date _____

Signature of physician _____ Date _____

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