Phosgene Oxime ($CHCl_2NO$)
CAS 1794-86-1

Synonyms include dichloroformoxime; CX.

Persons whose clothing or skin is contaminated with liquid or solid phosgene oxime can cause secondary contamination by direct contact or through off-gassing vapor. Persons exposed only to phosgene oxime vapor pose no risk of secondary contamination.

Phosgene oxime is a colorless, crystalline solid or a yellowish-brown liquid with a disagreeable penetrating odor. The solid can vaporize at ambient temperatures.

Phosgene oxime is readily absorbed by the skin causing an immediate corrosive lesion. Ocular and pulmonary exposure may cause incapacitating inflammation,

Description

Phosgene oxime is an urticant or nettle agent. It is one of the least well studied chemical warfare agents; therefore, specific information is limited. Pure phosgene oxime is a colorless, crystalline solid; however, the munitions grade compound is a yellowish-brown liquid. The solid material can release enough vapor to cause symptoms. Post World War II studies indicate that concentrations below 8% cause no or inconsistent effects.

Routes of Exposure

Inhalation

Inhaled phosgene oxime is extremely irritating to the upper airways and causes pulmonary edema. Irritation occurs with exposures to 0.2 mg-min/m^3 and becomes unbearable at 3 mg-min/m^3. The estimated LCt_{50} (the product of concentration times time that is lethal to 50% of the exposed population by inhalation) is 1,500 to 2,000 mg-min/m^3.

Skin/Eye Contact

Pain and local tissue destruction occur immediately on contact with skin, eyes and mucous membranes. Phosgene oxime is rapidly absorbed from the skin and eyes and may result in systemic toxicity. The LD_{50} for skin exposure is estimated as 25 mg/kg.

Ingestion

No human data are available. Animal studies suggest phosgene oxime may induce hemorrhagic inflammatory lesions in the gastrointestinal tract.

Sources/Uses

Phosgene oxime was developed as a potential chemical warfare agent but has never been known to be used on the battlefield.

Standards and Guidelines No standards are available.

Physical Properties

Table 1. Physical Properties of Phosgene Oxime

Property	Agent Phosgene Oxime
Description	Colorless solid or yellowish-brown liquid
Warning properties	No data
Molecular weight	113.93 daltons
Boiling point	(760 mm Hg) = 128 °C
Melting point	95 to 104 °F (35 to 40 °C)
Freezing point	No data
Vapor pressure	11.2 mm Hg at 25 °C (solid); 13 mm Hg at 40 °C (liquid)
Vapor density	<3.9
Liquid density	No data
Flash point	No data
Solubility in water	70% in water; highly soluble in most organic solvents
Volatility	1,800 mg/m^3 (20 °C)
NAERG#	153

Incompatibilities It decomposes when in contact with many metals, but it also is corrosive to most metals.

Health Effects

- **Direct contact with phosgene oxime results in immediate pain, irritation, and tissue necrosis. Inhalation and systemic absorption may result in pulmonary edema, necrotizing bronchiolitis, and pulmonary thrombosis.**
- **Phosgene oxime is known to cause more severe tissue damage than vesicants and other urticants but it has not been well studied and the mechanism of action is unknown.**

Acute Exposure

Phosgene oxime is an urticant or nettle agent capable of producing erythema, wheals, and urticaria. It is considered a corrosive agent because it causes extensive tissue damage. The skin effects are similar to those caused by strong acids; however, the mechanism of action is unknown.

Ocular

Contact with the eyes may result in severe pain, conjunctivitis, and keratitis.

Dermal

Direct skin exposure to any form of phosgene oxime causes immediate pain and blanching with an erythematous ring. After 30 minutes a wheal occurs followed by necrosis. Extreme pain may persist for days. Absorption through the skin can cause pulmonary edema.

Respiratory

Phosgene oxime produces immediate irritation to the upper respiratory tract. Inhalation and systemic absorption may cause pulmonary edema, necrotizing bronchiolitis and pulmonary thrombosis.

Gastrointestinal

There are no human data; however, animal studies suggest that hemorrhagic inflammatory lesions may occur throughout the gastrointestinal tract.

Chronic Exposure

There are no data regarding potential effects of chronic exposure to phosgene oxime.

Carcinogenicity

No data exist.

Reproductive and Developmental Effects

No data exist.

Prehospital Management

- **Victims whose skin or clothing is contaminated with liquid phosgene oxime can contaminate rescuers by direct contact or through off-gassing vapor.**
- **Phosgene oxime is extremely toxic and may cause immediate pain and necrotic lesions of the eyes, skin, and respiratory tract.**
- **There is no antidote for phosgene oxime toxicity. Treatment consists of supportive measures.**

Hot Zone

Responders should be trained and appropriately attired before entering the Hot Zone. If the proper personal protective equipment (PPE) is not available, or if the rescuers have not been trained in its use, call for assistance in accordance with local Emergency Operational Guides (EOG). Sources of such assistance include local HAZMAT teams, mutual aid partners, the closest metropolitan strike system (MMRS) and the U.S. Soldier and Biological Chemical Command (SBCCOM)-Edgewood Research Development and Engineering Center SBCCOM may be contacted (from 0700-1630 EST call 410-671-4411 and from 1630-0700 EST call 410-278-5201), ask for the Staff Duty Officer.

Rescuer Protection

Phosgene oxime is readily absorbed by inhalation and by dermal and ocular contact. It causes immediate irritation and pain.

Respiratory Protection: Pressure-demand, self-contained breathing apparatus (SCBA) is recommended in response situations that involve exposure to any level of phosgene oxime vapor.

Skin/Ocular Protection: Personal Protective Equipment (PPE) and butyl rubber gloves must be worn at all times when skin contact with any form of the material is possible because lesions and dermal absorption may occur. Phosgene oxime may attack the butyl rubber in the butyl rubber gloves and boots, which nevertheless, are expected to protect against field concentrations of phosgene oxime until they can be exchanged for fresh gloves and boots.

Multi-Casualty Triage

Chemical casualty triage is based on walking feasibility, respiratory status, age, and additional conventional injuries. The triage officer must know the natural course of a given injury, the medical resources immediately available, the current and likely casualty flow, and the medical evacuation capabilities. General

principles of triage for chemical exposures are presented in the box on the following page. There are four triage categories: immediate (priority 1), delayed (priority 2), minimal (priority 3), and expectant (priority 4).

Before transport, all casualties must be decontaminated. If needed, consult with the base station physician or the regional poison control center for advise concerning management of multiple casualties.

General principals of triage for chemical exposures are as follows:

- Check triage tag/card for any previous treatment or triage.
- Survey for evidence of associated traumatic/blast injuries.
- Observe for sweating, labored breathing, coughing/vomiting, secretions.
- Severe casualty triaged as immediate if assisted breathing is required.
- Blast injuries or other trauma, where there is question whether there is chemical exposure, victims must be tagged as immediate in most cases. Blast victims evidence delayed effects such as ARDS, etc.
- Mild/moderate casualty: self/buddy aid, triaged as delayed or minimal and release is based on strict follow up and instructions.
- If there are chemical exposure situations which may cause delayed but serious signs and symptoms, then overtriage is considered appropriate to the proper facilities that can observe and manage any delayed onset symptoms. *For phosgene oxime, effects are immediate. No overtriage would be anticipated.*
- Expectant categories in multi-casualty events are those victims who have experienced a cardiac arrest, respiratory arrest, or continued seizures immediately. Resources should not be expended on these casualties if there are large numbers of casualties requiring care and transport with minimal or scant resources available.

1. *Immediate:* casualties who require lifesaving care within a short time, when that care is available and of short duration. This care may be a procedure that can be done within minutes at an emergency treatment station (e.g., relief of an airway obstruction, administering antidotes) or may be acute lifesaving surgery.

2. *Delayed:* casualties with severe injuries who are in need of major or prolonged surgery or other care and who will require hospitalization, but delay of this care will not adversely affect the outcome of the injury (e.g., fixation of a stable fracture).

3. *Minimal:* casualties who have minor injuries, can be helped by nonphysician medical personnel, and will not require hospitalization.

4. *Expectant:* casualties with severe life-threatening injuries who would not survive with optimal medical care, or casualties whose injuries are so severe that their chance of survival does not justify expenditure of limited resources. As circumstances permit, casualties in this category may be reexamined an possibly be retriaged to a higher category.

ABC Reminders

Quickly ensure that the victim has a patent airway. Maintain adequate circulation. If trauma is suspected, maintain cervical immobilization manually and apply a cervical collar and a backboard when feasible. Apply direct pressure to stop arterial bleeding, if present.

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.

Decontamination Zone

Decontamination or self-aid immediately after skin and ocular exposure is the only means for preventing or decreasing tissue damage since phosgene oxime is absorbed within seconds. Decontaminable gurneys and back boards should be used if available when managing casualties in a contaminated area. Decontaminable gurneys are made of a monofilament polypropylene fabric that allows drainage of liquids, does not absorb chemical agents, and is easily decontaminated. Fiberglass back boards have been developed specifically for use in HAZMAT incidents. These are nonpermeable and readily decontaminated. The **Chemical Resuscitation Device** is a bag-valve mask equipped with a chemical agent cannister that can be used to ventilate casualties in a contaminated environment.

Rescuer Protection

Personnel should continue to wear the same level of protection as required in the Hot Zone (see *Rescuer Protection* under *Hot Zone*, above).

ABC Reminders

Quickly ensure that the victim has a patent airway. Maintain adequate circulation. Stabilize the cervical spine with a decontaminable collar and a backboard if trauma is suspected. Administer supplemental oxygen if cardiopulmonary compromise is suspected. Assist ventilation with a bag-valve-mask device equipped with a cannister or air filter if necessary. Direct pressure should be applied to control bleeding, if present.

Basic Decontamination

The eyes and skin must be decontaminated immediately after exposure because the agent is absorbed from the skin within seconds. Flush the eyes immediately with water for about 5 to 10 minutes by tilting the head to the side, pulling eyelids apart with fingers, and pouring water slowly into eyes. Do not cover eyes with bandages.

If exposure to liquid is suspected, victims should remove all clothing and wash skin with soap and water. If shower areas are available, showering with water alone will be adequate. However, in those cases where water is in short supply, and showers are not available, an alternative form of decontamination is to use 0.5% sodium hypochlorite solution or absorbent powders such as flour, talcum powder, or Fuller's earth. If exposure to vapor only is certain, remove outer clothing and wash with soap and water or 0.5% solution of sodium hypochlorite. Place contaminated clothes and personal belongings in a sealed double bag.

In cases of ingestion, **do not induce emesis**.

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 phosgene oxime vapor pose no serious risk of secondary contamination to rescuers. In such cases, Support Zone personnel require no specialized protective gear.

ABC Reminders

Quickly ensure that the victim has a patent airway. If trauma is suspected, maintain cervical immobilization manually and apply a cervical collar and a backboard when feasible. Ensure adequate respiration; administer supplemental oxygen if cardiopulmonary compromise is suspected. Maintain adequate circulation. Establish intravenous access if necessary. Attach a cardiac monitor. Direct pressure should be applied to stop bleeding, if present.

Additional Decontamination

Continue irrigating exposed skin and eyes, as appropriate.

In cases of ingestion, **do not induce emesis**. If the victim is alert and able to swallow, give 4 to 8 ounces of milk or water to drink. There are no data regarding the efficacy of activated charcoal.

Advanced Treatment

Intubate the trachea in cases of respiratory compromise. When the patient's condition precludes endotracheal intubation, perform cricothyrotomy if equipped and trained to do so.

Treat patients who have bronchospasm with bronchodilators.

Patients who are comatose or hypotensive, or have seizures or ventricular dysrhythmias due to other exposures or trauma should be treated according to advanced life support (ALS) protocols.

Transport to Medical Facility

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

Multi-Casualty Triage

Consult with the base station physician, closest Metropolitan Medical Response System, or the regional poison control center for advice regarding triage of multiple victims.

Patients who have sustained skin, eye, or respiratory lesions and those who have ingested phosgene oxime should be transported to a medical facility for evaluation.

Patients who have no symptoms may be discharged from the scene, after their names, addresses, and telephone numbers have been recorded. They should be advised to rest and to seek medical care promptly if additional symptoms develop (see *Follow-up Instructions*, included with the *Phosgene Oxime Patient Information Sheet* below).

Emergency Department Management

- **Patients whose skin or clothing is contaminated with liquid or solid phosgene oxime can contaminate rescuers by direct contact or through off-gassing vapor.**
- **Phosgene oxime is extremely toxic and may cause immediate pain and necrotic lesions of the eyes, skin, and respiratory tract.**
- **There is no antidote for phosgene oxime toxicity. Treatment consists of supportive measures.**

Decontamination Area

Previously decontaminated patients may be transferred immediately to the Treatment Area. Others require decontamination as described below.

ABC Reminders

Evaluate and support the airway, breathing, and circulation. Intubate the trachea in cases of respiratory compromise. If the patient's condition precludes intubation, surgically create an airway.

Treat patients who have bronchospasm with bronchodilators.

Patients who are comatose or hypotensive, or have seizures or ventricular dysrhythmias due to other exposures or trauma should be treated in the conventional manner.

Personal Protection

If contaminated patients arrive at the Emergency Department, they must be decontaminated before being allowed to enter the facility. Decontamination can take place inside the hospital only if there is a decontamination facility with negative air pressure and floor drains to contain contamination. Personnel should wear the same level of protection required in the Hot Zone (see *Rescuer Protection* under Hot Zone, above).

Basic Decontamination

Flush the eyes with water for about 5 to 10 minutes. Do not cover eyes with bandages; if necessary, use dark or opaque goggles to relieve discomfort from photophobia.

If a liquid splash is suspected, clothing must be removed and the patient showered using soap and water. Showering should be accomplished using cool water and enough water pressure to quickly reduce the potential for agent penetration of the skin. If the patient was exposed to vapor only, remove outer clothing and wash exposed skin with soap and water. Place contaminated clothes and personal belongings in a sealed double bag.

In cases of ingestion, **do not induce emesis**. If the patient is alert and able to swallow, give 4 to 8 ounces of milk or water to drink if not already administered.

Treatment Area

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

ABC Reminders

Evaluate and support the airway, breathing, and circulation (as in *ABC Reminders*, previous page). Establish intravenous access and continuously monitor cardiac rhythm in seriously ill patients.

Patients who are comatose, hypotensive, or who have seizures or ventricular dysrhythmias due to other exposures or trauma should be treated in the conventional manner.

Triage

Patients arriving at the emergency department directly from the scene of potential exposure (within 30-60 minutes) will have pain or irritation if they were exposed. If they have no pain or irritation, they can safely be sent home and told to return with the onset of symptoms. Patients with skin or eye lesions or with respiratory symptoms should undergo decontamination and be admitted. Those with large burns or with shortness of breath should be admitted to the Critical Care Unit following appropriate decontamination. Patients with other symptoms should be observed for at least 6 hours.

Airway Exposure

Patients with minor upper-respiratory symptoms (nose, sinus, pharyngitis) should be admitted to a routine care ward for treatment. Pulmonary edema may develop several hours after exposure. Patients with symptoms or signs of severe respiratory injury should be admitted to the Critical Care Unit for treatment in a conventional manner for non-cardiac pulmonary edema.

Skin Exposure

If the skin was in contact with phosgene oxime, treat tissue damage in the same manner as for any corrosive lesion. If the burned area is large, the patient should be transferred to a Burn Unit with reverse isolation. Most burns are second degree although third degree burns may occur after liquid exposure. The denuded area should be irrigated two or three times a day using a whirlpool if the lesion is large (the patient should be given ample amounts of a systemic analgesic beforehand). This should be followed by liberal application of a topical antibiotic. Skin lesions may take many months to heal. Systemic antibiotics should be used when there are signs of infection and a culture indicates the responsible organism.

Eye Exposure

Mild conjunctivitis beginning more than 12 hours after exposure is unlikely to progress to a severe lesion. The patient should have a thorough eye examination (including a test for visual acuity), treatment with a soothing eye solution such as Visine or Murine, and be advised to return if there is worsening. Conjunctivitis beginning earlier and other effects such as lid swelling and signs/symptoms of inflammation indicate need for inpatient care and observation.

Lesions more severe than conjunctivitis may be treated with a topical mydriatic (e.g., atropine), topical antibiotics, and vaseline or similar substance applied to the lid edges several times a day. Consult an ophthalmologist for patients with severe corneal injuries. Topical analgesics should be used only for an initial examination (including slit lamp and a test of visual acuity), but not after. Pain may be controlled with systemic analgesics. Once the lid edema and blepharospasm subside and the eyes are open, dark glasses may reduce the discomfort of photophobia.

Ingestion Exposure

Do not induce emesis. Treat nausea and vomiting with antiemetics.

Antidotes and Other Treatments

There is no antidote for phosgene oxime. Treatment is supportive.

Laboratory Tests

Routine laboratory studies should be done for all patients requiring admission. These include CBC, glucose, serum electrolytes, liver enzymes, and kidney function tests. Chest X-ray and pulse oximetry (or ABG measurements) are recommended for inhalation exposures.

Disposition and Follow-up

Patients with moderate to severe exposures will require hospitalization, as discussed above.

Patient Release

Patients with no symptoms may be discharged. Discharged patients should be advised to rest and to seek medical care promptly if symptoms develop (see *Follow-up Instructions*, included with the *Phosgene Oxime Patient Information Sheet* below).

Follow-up

Patients who have mild skin burns should be reexamined within 24 hours.

Reporting

Other persons may still be at risk in the setting where this incident occurred. If a public health risk exists, notify your state or local health department or other responsible public agency.

Phosgene Oxime ($CHCl_2NO$)
Patient Information Sheet

This handout provides information and follow-up instructions for persons who have been exposed to phosgene oxime.

What is phosgene oxime?
Phosgene oxime is a colorless, crystalline solid or a yellowish-brown liquid. It is classified as a urticant or nettle chemical warfare agent; however, it has not been used on the battlefield.

What immediate health effects can be caused by exposure to phosgene oxime?
Phosgene oxime causes immediate and painful skin and eye lesions. Inhalation causes fluid to accumulate in the lungs and severe bronchitis.

Can phosgene oxime poisoning be treated?
There is no antidote for phosgene oxime. Its effects can be treated in the same way as burns from other causes (e.g., strong acids). Exposed persons may need to be hospitalized.

Are any future health effects likely to occur?
There is no information evaluating future health effects.

What tests can be done if a person has been exposed to phosgene oxime?
There are no specific tests to confirm exposure.

Where can more information about phosgene oxime be found?
Phosgene oxime is one of the least well studied chemical warfare agents; therefore, specific information is limited. More information about phosgene oxime may be obtained from your regional poison control center; the Agency for Toxic Substances and Disease Registry (ATSDR); your doctor; or a clinic in your area that specializes in toxicology or occupational and environmental health. Ask the person who gave you this form for help 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:

- coughing, wheezing, or shortness of breath
- increased pain or discharge from injured eyes
- increased redness, pain, or a pus-like discharge from injured skin

[ ] 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 to 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 _____