

Chemical Emergency Medical Guideline

Information and recommendations for healthcare professionals

Tetrahydrofuran

CAS No.: 109-99-9

GHS symbols:



GHS07

Acute toxicity



GHS08

Health hazard

Signal word: Danger

Hazard statements:

H302	Harmful if swallowed.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.
H336	May cause drowsiness or dizziness.
H351	Suspected of causing cancer.

Overview

- There is no danger from contact with patients who have only been exposed to tetrahydrofuran vapors. A patient who is wet with liquid tetrahydrofuran (boiling point 66°C) or whose clothing is wet with it may endanger other people through direct contact or through evaporating tetrahydrofuran.
- Tetrahydrofuran irritates the skin, eyes and respiratory tract and can cause headaches, nausea, dizziness, weakness, confusion and unconsciousness. Inhalation can lead to unconsciousness.
- There is no known specific antidote. Treatment depends on the extent of exposure and the symptoms.

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1. Information on the substance

Tetrahydrofuran (C₄H₈O), CAS 109-99-9

Synonyms: THF, tetramethylene oxide

Tetrahydrofuran is a clear, colorless liquid at room temperature (boiling point 66°C). The vapor and liquid are flammable. Tetrahydrofuran has an acetone- or ether-like odor. The odor threshold is 2–7.4 ppm. It is miscible with organic solvents. Combustion can produce explosive peroxide and carbon monoxide.

Tetrahydrofuran is an organic solvent for natural and synthetic polymers and resins. It is used in the manufacture of lacquers, adhesives, paints and inks, and in textile production.

2. Exposition

2.1. Inhalation

Exposure to tetrahydrofuran occurs mainly through inhalation. Tetrahydrofuran is rapidly absorbed through the lungs.

2.2. Skin/eye contact

Tetrahydrofuran is absorbed through the skin and can lead to general symptoms of poisoning.

2.3. Ingestion

Tetrahydrofuran is absorbed through the gastrointestinal tract. However, ingestion is rare in the workplace. If swallowed, it can also enter the respiratory tract.

3. Acute health effects

3.1. Dose-response relationship

<u>Tetrahydrofuran concentration</u>	<u>Effect/effects</u>
2 – 7.4 ppm	- Odor threshold
50 ppm	- Occupational exposure limit TWA (EU)
100 ppm	- STEL (short-term exposure limit, EU)
200 ppm	- Occupational exposure limit (NIOSH, USA)
250 ppm	- STEL (NIOSH, USA)
2000 ppm	- IDLH (NIOSH, USA)
25,000 ppm	- Unconsciousness

Occupational exposure limit: According to the Hazardous Substances Ordinance, the occupational exposure limit (OEL) is the limit value for the time-weighted average concentration of a substance in the air at the workplace in relation to a given reference period. It specifies the concentration of a substance at which acute or chronic harmful effects on health are generally not to be expected.

TWA: Time-weighted average

STEL: Short-Term Exposure Limit → Average concentration over 15 minutes to which workers may be exposed up to four times per day with at least 60 minutes between successive exposures without adverse health effects

IDLH: Immediately Dangerous to Life and Health

NIOSH: National Institute for Occupational Safety and Health

3.2. Systemic effects

Tetrahydrofuran can cause general symptoms of poisoning such as headache, nausea, dizziness, weakness, confusion and unconsciousness. Exposure to high concentrations may cause signs of upper respiratory tract irritation, followed by asphyxia, muscle weakness, cardiac arrhythmia, coma and respiratory arrest. Central nervous system disorders and liver enzyme changes may occur.

3.3. Respiratory tract

Tetrahydrofuran may irritate the upper respiratory tract.

3.4. Skin

Local exposure to liquid tetrahydrofuran may cause skin irritation.

3.5. Eye contact

Local exposure to liquid tetrahydrofuran or high vapor concentrations may cause eye irritation with redness, burning, tearing or spasmodic eyelid closure.

3.6. Possible consequences

If the patient survives the first 48 hours after exposure, further improvement in symptoms can be expected. After acute exposure, lung function usually returns to normal within 7 to 14 days. Complete recovery is usually achieved. Increased sensitivity to irritants may persist and cause bronchospasm or chronic bronchitis. Such "reactive airways dysfunction syndrome" (RADS) may persist for several years. Destruction of lung tissue or scarring can lead to chronic dilation of the bronchi and increased susceptibility to infections. Central nervous system disorders, liver and kidney damage may occur.

4. Measures

4.1. Self-protection for first aiders

If there is a suspicion that the area the helper must enter contains tetrahydrofuran, a self-contained breathing apparatus and a chemical protection suit must be worn.

There is no danger from contact with patients who have only been exposed to tetrahydrofuran vapors. A patient who is wet with liquid tetrahydrofuran or whose clothing is wet with liquid tetrahydrofuran may endanger other people through direct contact or through evaporating tetrahydrofuran.

4.2. Rescue

Patients should be removed from the danger zone immediately. If they are unable to walk unaided, they should be removed from the danger zone quickly using appropriate means, taking care to protect yourself. The "A, B, C procedure" then takes absolute priority.

- A) Clear the airways** (check for blockages caused by the tongue or foreign objects)
- B) Ventilation** (check the patient's breathing, if necessary, begin ventilation with adequate self-protection, e.g. breathing mask)
- C) Circulation** (begin resuscitation for any person who does not respond to verbal commands and is not breathing normally)

4.3. Cleaning

Patients who have only been exposed to tetrahydrofuran vapors and show no signs of skin or eye irritation do not require any special cleaning measures, unlike all others. If possible, patients should assist in their own cleaning. If liquid tetrahydrofuran has been exposed and clothing is contaminated, it must be removed and securely wrapped.

In the event of exposure to tetrahydrofuran, rinse the eyes with water or neutral saline solution for at least 15 minutes. If rinsing is impeded by eyelid spasm, the use of a local anesthetic solution (e.g. lidocaine, oxybuprocaine) may be considered. Remove any contact lenses, if possible, without additional risk to the eye.

Rinse affected skin and hair with water for at least 15 minutes. Other important supportive measures must be continued during this time. Protect eyes while rinsing.

4.4. Initial treatment (preclinical or clinical)

Empirical therapy; no specific antidote available.

The following measures are recommended if the tetrahydrofuran concentration is 50 to 200ppm or more (depending on the duration of exposure), if symptoms are present (e.g. irritation of the eyes or upper respiratory tract) or if no concentration can be estimated but exposure is very likely:

- Oxygen administration
- Administration of 8 sprays of beclomethasone (800µg beclomethasone dipropionate) from a metered dose inhaler.

If there are signs of airway constriction (e.g. bronchospasm or stridor)

- Nebulization of adrenalin (epinephrine): mix 2mg adrenalin (2ml) with 3ml NaCl 0.9% and administer via a nebulizer mask
- Administration of a β 2-selective adrenoceptor agonist, e.g. four puffs of terbutaline or salbutamol or fenoterol (one puff usually contains 0.25mg terbutaline sulphate; or 0.1mg salbutamol; or 0.2mg fenoterol); this can be repeated once after 10 minutes.

Alternatively, 2.5mg of salbutamol and 0.5mg of ipratropium bromide can be administered via a nebulizer mask.

If inhalation is not possible, administer terbutaline sulphate (0.25mg to 0.5mg) subcutaneously or salbutamol (0.2mg to 0.4mg over 15 minutes) intravenously.

Intravenous administration of 250mg methylprednisolone (or an equivalent steroid dose).

If there are signs of toxic pulmonary oedema (e.g. frothy sputum, moist rales)

- CPAP therapy
- Intravenous administration of 1000mg methylprednisolone (or an equivalent steroid dose)
In case of (increasing) respiratory insufficiency, advanced airway management, e.g. endotracheal intubation or coniotomy if necessary.

Note: The efficacy of corticosteroid administration has not yet been proven in controlled clinical trials.

Skin contact with liquid tetrahydrofuran can cause skin irritation; this should be treated as a burn.

Exposure of the eyes may also cause irritation; this should also be treated as a burn. Consult an ophthalmologist.

4.5. Further procedure and treatment

In addition to taking medical history, performing a physical examination and checking vital signs, pulse oximetry, a chest X-ray and spirometry should be performed. Routine laboratory tests should include complete blood count, glucose and electrolytes.

Clear radiological signs of pulmonary oedema – enlargement of the hila, typical, centrally accentuated, patchy shadows on the chest X-ray – are late signs that often cannot be detected until 24 hours after exposure. The X-ray is typically still normal at the initial presentation at the hospital, even after inhalation of a relevant dose.

Patients with possible exposure or with significant complaints or symptoms should be monitored for an appropriate period and re-examined repeatedly before any consequential damage to health can be ruled out. Delayed effects in patients with only mild, rapidly subsiding symptoms of the upper respiratory tract (mild burning or coughing) are unlikely.

If oxygen saturation falls below 90%, arterial blood gas concentrations must be checked immediately and the chest X-ray repeated. If blood gas concentrations deteriorate and/or the chest X-ray shows signs of toxic pulmonary oedema, oxygen should be administered via a mask. If deterioration becomes apparent (especially in the case of tachypnoea (>30/min) and a simultaneous decrease in carbon dioxide partial pressure), CPAP therapy should be started within the first 24 hours after exposure.

In the event of pulmonary oedema developing, fluid intake and excretion as well as electrolytes should be closely monitored. A positive balance should be avoided. To optimize fluid management, the insertion of a central venous catheter should be considered.

If signs of pulmonary oedema persist, intravenous administration of methylprednisolone (or an equivalent steroid) should be continued at intervals of 8 to 12 hours.

Prophylactic antibiotic administration is not routinely recommended but may be considered based on the results of sputum cultures. Pneumonia may occur as a complication of severe pulmonary edema.

Irritation or chemical burns should be re-examined at short intervals during the first 24 hours after exposure.

4.6. Biomonitoring

Biomonitoring with determination of tetrahydrofuran concentration in urine can be performed to estimate the systemic dose absorbed after exposure.

4.7. Discharge of the patient / instructions for further rules of conduct

Clinically asymptomatic patients who have been exposed to tetrahydrofuran concentrations of less than 100ppm to 250ppm (depending on the duration of exposure) or who have had only minor contact with liquid tetrahydrofuran and show no abnormal clinical findings and no signs of toxic effects after an appropriate follow-up period may be discharged under the following circumstances:

- Information and recommendations for patients with instructions for further action have been provided verbally and in writing. The patient has been instructed to seek immediate medical attention if any health complaints arise.
- The doctor believes that the patient is aware of and understands the toxic effects of tetrahydrofuran.
- The attending physician has been informed that regular contact between the patient and the physician is possible in the following 24 hours.
- Drinking alcohol should be prohibited for at least 72 hours.
- Heavy physical work should not be done in the following 24 hours.
- Do not smoke or be exposed to cigarette smoke for at least 72 hours; smoke can impair lung function.
- Patients with serious skin or eye injuries should be re-examined after 24 hours.

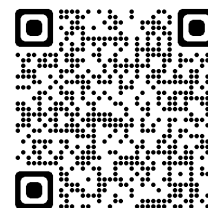
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Administrative Information

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