

## Methyl Mercaptan (CH<sub>3</sub>SH) CAS 74-93-1; UN 1064

Synonyms include methanethiol, mercaptomethane, thiomethanol, methyl sulfhydrate, and thiomethyl alcohol.

- **Persons exposed only to methyl mercaptan pose little risk of secondary contamination to personnel outside the Hot Zone.**
- **Methyl mercaptan is a colorless flammable gas with unpleasant odor described as rotten cabbage. It is easily ignited. When heated to decomposition, it emits highly toxic fumes and flammable vapors. Vapors from liquified methyl mercaptan gas are heavier than air and may collect in low-lying areas. Olfactory fatigue may prevent adequate warning of hazardous concentrations.**
- **Methyl mercaptan is highly irritant when it contacts moist tissues such as the eyes, skin, and upper respiratory tract. It can also induce headache, dizziness, nausea, vomiting, coma, and death. Ingestion of methyl mercaptan is unlikely since it is a gas at ambient temperatures.**

### Description

At room temperature (above 43 °F), methyl mercaptan is a colorless gas with an unpleasant odor described as rotten cabbage. It is slightly soluble in water. It is generally shipped as a liquified compressed gas. When heated to decomposition, it emits toxic fumes, such as sulfur dioxide, and flammable vapors. Methyl mercaptan should be stored in cool, well ventilated places. The main toxic effect of exposure to methyl mercaptan is irritation of the respiratory airway, skin, and eyes.

### Routes of Exposure

#### *Inhalation*

Inhalation is the major route of exposure to methyl mercaptan. An odor threshold of 0.002 ppm has been reported for methyl mercaptan, but olfactory fatigue may occur and thus, it **may not provide adequate warning of hazardous concentrations**. Vapors of liquified methyl mercaptan gas are heavier than air and spread along the ground. Exposure in poorly ventilated, enclosed, or low-lying areas can result in asphyxiation.

Children exposed to the same levels of methyl mercaptan as adults may receive a larger dose because they have a greater lung surface area:body weight ratios and higher minute volume: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 methyl mercaptan found nearer to the ground.

*Skin/Eye Contact*

Direct contact with liquid methyl mercaptan or the gas may cause frostbite injury or irritation of the eyes and skin.

*Ingestion*

Ingestion is unlikely to occur because methyl mercaptan is a gas at room temperature.

**Sources/Uses**

Methyl mercaptan is produced by the reaction of hydrogen sulfide with methanol. It is used as a gas odorant; an intermediate in the production of pesticides, jet fuels, and plastics; in the synthesis of methionine; and as a catalyst.

**Standards and Guidelines**

OSHA PEL (permissible exposure limit) = 10 ppm (20 mg/m<sup>3</sup>)

NIOSH REL (recommended exposure limit) = 0.5 ppm

NIOSH IDLH (immediately dangerous to life or health) = 150 ppm

AIHA ERPG-2 (maximum airborne concentration below which it is believed that nearly all persons could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action) = 25 ppm.

**Physical Properties**

*Description:* Colorless flammable gas at room temperature

*Warning properties:* Odor does not provide adequate warning of hazard

*Molecular weight:* 48.1 daltons

*Boiling point:* (760 mm Hg) = 43 °F (6 °C)

*Freezing point:* -186 °F (-123 °C)

*Specific gravity (liquid):* 0.87 at 0 °C

*Vapor pressure:* 1,520 mm Hg at 26 °C

*Gas density:* 1.66 (air = 1)

*Water solubility:* 23.3 g/L at 20 °C

*Flammability:* flammable limits 3.9% to 21.8% at room temperature

**Incompatibilities**

Methyl mercaptan is incompatible with strong oxidizers, bleaches, copper, aluminum, and nickel-copper alloys.

## Health Effects

- **Methyl mercaptan gas is irritating to the eyes, skin, and respiratory tract. Edema of the airway and lungs can occur. Other possible effects include headache, dizziness, tremors, and seizures, and nausea and vomiting, and lack of coordination. The gas is rapidly absorbed in the lungs. Skin and eye absorption are minimal; however, upon direct contact with eyes or skin, liquified methyl mercaptan will likely cause frostbite injury.**
- **Methyl mercaptan is a central nervous system depressant that acts on the respiratory center to produce death by respiratory paralysis.**
- **Individuals with pre-existing respiratory, cardiac, nervous system, or liver impairment may be more susceptible to exposure to methyl mercaptan.**

### Acute Exposure

Methyl mercaptan inhibits mitochondrial respiration by interfering with cytochrome c oxidase. It also inhibits several enzyme systems such as carbonic anhydrase, beta-tyrosinase, and sodium+, potassium+ATPase. The enzyme inhibition appears to be related to a thiol-metal interference.

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

### *Respiratory*

Acute inhalation exposure can irritate the mucous membranes of the respiratory tract. This may cause cough, dyspnea, a sensation of tightness of the chest, and subsequent cyanosis. Respiratory depression, apnea, and pulmonary edema were observed in animals.

Children may be more vulnerable to gas exposure because of relatively higher minute ventilation per kg and failure to evacuate an area promptly when exposed.

### *Hematologic*

Severe hemolytic anemia may occur in people with glucose-6-phosphate dehydrogenase deficiency.

### *Neurologic*

Restlessness, headache, staggering, and dizziness may develop; severe exposure may lead to convulsions and coma.

### *Dermal*

Frostbite injury can occur from contact with the liquified gas.

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

*Ocular/Ophthalmic*

High concentrations of methyl mercaptan can cause eye irritation.

*Gastrointestinal*

Although ingestion is unlikely, irritation of the mouth, throat, and esophagus are possible. Nausea and vomiting may occur even with inhalation exposure to the gas.

*Potential Sequelae*

Methyl mercaptan exposure may result in altered heme synthesis.

**Chronic Exposure**

Dermatitis can occur with chronic exposure to methyl mercaptan.

*Carcinogenicity*

Methyl mercaptan has not been classified for carcinogenic effects.

*Reproductive and  
Developmental Effects*

No information is available regarding reproductive or developmental effects of methyl mercaptan in experimental animals or humans. Methyl mercaptan is not included in *Reproductive and Developmental Toxicants*, a 1991 report published by the U.S. General Accounting Office (GAO) that lists 30 chemicals of concern because of widely acknowledged reproductive and developmental consequences.

## Prehospital Management

- **Rescue personnel are at low risk of secondary contamination from victims who have been exposed to methyl mercaptan gas. However, rescuers entering areas with potential high concentrations should wear appropriate equipment to avoid self-exposure to methyl mercaptan.**
- **Acute exposure to methyl mercaptan gas causes chest tightness, coughing, and skin and eye irritation. Respiratory impairment and noncardiogenic pulmonary edema may occur. Headache, dizziness, and staggering gait can also occur.**
- **There is no specific antidote for methyl mercaptan poisoning. Treatment is supportive of respiratory and cardiovascular functions.**

### 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. Open flames and other ignition sources should be excluded from areas containing methyl mercaptan gas.

### Rescuer Protection

Methyl mercaptan is a central nervous system depressant as well as respiratory-tract and skin irritant. Vapors are well absorbed through the lungs. Skin absorption is minimal.

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

*Skin Protection:* Chemical-protective clothing should be worn because contact with the liquified gas can cause skin irritation and frostbite injury.

### 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.

Consider appropriate management of chemically contaminated victims, particularly children who may suffer separation anxiety if separated from a parent or other adult.

**Decontamination Zone**

Victims exposed to methyl mercaptan gas who have no skin or eye irritation do not need decontamination. They may be transferred immediately to the Support Zone. All others 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. Remove and double-bag contaminated clothing and personal belongings.

Flush exposed skin and hair with water for 3 to 5 minutes. Wash exposed area thoroughly with soap and water. Use caution to avoid hypothermia when decontaminating victims, particularly children or the elderly. Use blankets or warmers after decontamination as needed.

Do not irrigate eyes that have sustained frostbite injury. Otherwise, irrigate exposed or irritated eyes with copious amounts of tepid water for at least 15 minutes. Eye irrigation may be carried out simultaneously with other basic care and transport. Remove contact lenses if it can be done without additional trauma to the eye. If pain or injury is evident, continue irrigation while transferring the victim to the support zone.

Consider appropriate management of chemically contaminated children at the exposure site. Provide reassurance to the child during decontamination, especially 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 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 and 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, if available. Watch for signs of airway swelling and obstruction such as progressive hoarseness, stridor, or cyanosis.

*Additional Decontamination*

Continue irrigating exposed skin and eyes, as appropriate.

*Advanced Treatment*

Treat cases of respiratory compromise with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel.

Treat patients who have bronchospasm with an aerosolized bronchodilator such as albuterol.

Treat seizures with a benzodiazepine such as diazepam. Severe hypertension may be treated according to local protocols, although nitro prusside may be the best choice for treating methyl mercaptan-induced hypertension.

Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine solution, repeat every 20 minutes as needed.

Patients who are comatose, hypotensive, or having seizures or who have cardiac arrhythmias should be treated according to advanced life support (ALS) protocols.

If frostbite is present, treat by rewarming in a water bath at a temperature of 104–108 °F (40–42 °C) for 20 to 30 minutes and continue until a flush has returned to the affected area.



*Transport to Medical Facility*

Only decontaminated patients or those 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.

**Multi-Casualty Triage**

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

Patients with evidence of significant exposure (e.g., severe or persistent cough, dyspnea or chemical burns) should be transported to a medical facility for evaluation. Patients who have minor or transient irritation of the eyes or throat may be discharged from the scene after their names, addresses, and telephone numbers are recorded. They should be advised to seek medical care promptly if symptoms develop or recur (see *Patient Information Sheet* below).

## Emergency Department Management

- **Hospital personnel are at minimal risk of secondary contamination from patients who have been exposed to methyl mercaptan. However, hospital personnel in an enclosed area can be secondarily contaminated by vapors off-gassing from heavily contaminated clothing or skin.**
- **Acute exposure to methyl mercaptan causes coughing, eye and nose irritation, lacrimation, and a burning sensation in the chest; noncardiogenic pulmonary edema may occur. Headache, dizziness, and staggering gait can also occur.**
- **Methyl mercaptan irritates the skin and eyes and can cause burning pain and blisters. Exposure to liquefied methyl mercaptan can result in frostbite.**
- **There is no specific antidote for methyl mercaptan poisoning. Treatment consists of support of respiratory and cardiovascular functions.**

### Decontamination Area

Unless previously decontaminated, all patients with skin or eye irritation require decontamination as described below.

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

### ABC Reminders

Evaluate and support airway, breathing, and circulation. Treat cases of respiratory compromise with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyrotomy by properly trained and equipped personnel.

Treat patients who have bronchospasm with an aerosolized bronchodilator such as albuterol.

Treat seizures with a benzodiazepine such as diazepam. Severe hypertension may be treated according to local protocols, although nitro prusside may be the best choice for treating methyl mercaptan-induced hypertension.

Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine solution, repeat every 20 minutes as needed.

Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated in the conventional manner.

*Basic Decontamination*

Patients who are able may assist with their own decontamination. Remove and double bag contaminated clothing and personal belongings.

If skin and eye contact with liquified methyl mercaptan occurred, handle frostbite with caution. Place frostbitten skin in warm water, 104–108 °F (40–42 °C). If warm water is not available, wrap the affected part gently in blankets. Let the circulation reestablish itself naturally. Encourage the victim to exercise the affected part while it is being warmed.

Flush exposed skin and hair with plain water for no less than 15 minutes. Wash exposed area thoroughly with soap and water. Use caution to avoid hypothermia when decontaminating victims, particularly children or the elderly. Use blankets or warmers after decontamination as needed.

Do not irrigate frostbitten eyes. Eye irritation that does not involve frostbite should be irrigated conventionally. Remove contact lenses if it can be done without additional trauma to the eye. Continue irrigation while transporting the patient to the Critical Care Area.

**Critical Care Area**

Be certain that appropriate decontamination has been carried out.

*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, if appropriate.

Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated in the conventional manner.

*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.

Treat seizures with a benzodiazepine such as diazepam. Severe hypertension may be treated according to local protocols, although nitro prusside may be the best choice for treating methyl mercaptan-induced hypertension.

Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine solution, repeat every 20 minutes as needed.

If pulmonary edema develops, 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. Prophylactic antibiotic therapy may reduce the chances of respiratory infection.

#### *Skin Exposure*

If the skin was in contact with methyl mercaptan, thermal burns may occur. Treat thermal burns by assuring that affected area is cool by flushing with cool water, then apply dry sterile dressings.

If the liquefied methyl mercaptan gas contacts the skin, frostbite may result. If a victim has frostbite, treat by rewarming affected areas in a water bath at a temperature of 104–108 °F (40–42 °C) for 20 to 30 minutes and continue until a flush has returned to the affected area.

#### *Eye Exposure*

Exposed eyes should be irrigated for at least 15 minutes. Test visual acuity and examine the eyes for corneal damage and treat appropriately. Immediately consult an ophthalmologist for patients who have corneal injuries.

#### *Antidotes and Other Treatments*

There is no specific antidote for methyl mercaptan. Treatment is supportive.

#### *Laboratory Tests*

The diagnosis of acute methyl mercaptan toxicity is primarily clinical, based on respiratory difficulties and irritation. However, laboratory testing is useful for monitoring the patient and evaluating complications. Routine laboratory studies for all exposed patients include CBC, glucose, and electrolyte determinations. Patients who have respiratory complaints require pulse oximetry (or ABG measurements) and chest radiography. Massive inhalation may be complicated by hyperchloremic metabolic acidosis; in addition to electrolytes, monitor blood pH.

#### **Disposition and Follow-up**

Consider hospitalizing patients who have a suspected significant exposure or have eye burns or serious skin burns.

#### *Delayed Effects*

Symptomatic patients complaining of persistent shortness of breath, severe cough, or chest tightness should be admitted to the hospital

and observed until symptom-free. Pulmonary injury may progress for several hours.

*Patient Release*

Asymptomatic patients and those who experienced only minor sensations of burning of the nose, throat, eyes, and respiratory tract (with perhaps a slight cough) may be released. In most cases, these patients will be free of symptoms in an hour or less. They should be advised to seek medical care promptly if symptoms develop or recur (see the *Methyl Mercaptan—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 ED visit to the patient's doctor.

Follow up is recommended for all hospitalized patients because long-term respiratory problems can result. Respiratory monitoring is recommended until the patient is symptom-free.

Patients who have skin or corneal injury should be re-examined within 24 hours. Anyone who had significant dermal exposure should be followed for several months.

**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.

## **Methyl Mercaptan Patient Information Sheet**

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

### **What is methyl mercaptan?**

Methyl mercaptan is a flammable colorless gas with unpleasant odor described as rotten cabbage. It is used as a gas odorant; an intermediate in the production of pesticides, jet fuels, and plastics; and in the synthesis of the amino acid methionine. Because methyl mercaptan is a gas at ambient temperature, the most likely exposure routes are inhalation and dermal.

### **What immediate health effects can be caused by exposure to methyl mercaptan?**

Exposure to methyl mercaptan may cause immediate irritation of the eyes, nose, and throat, and shortness of breath, as well as coughing, wheezing, shortness of breath, and tearing of the eyes. Exposure to methyl mercaptan can also cause nausea and vomiting and dizziness, headache, and lack of coordination. Generally, the more serious the exposure, the more severe the symptoms.

### **Can methyl mercaptan poisoning be treated?**

There is no antidote for methyl mercaptan, but its effects can be treated and most exposed persons get well. Persons who have experienced serious symptoms may need to be hospitalized.

### **Are any future health effects likely to occur?**

A single small exposure from which a person recovers quickly is not likely to cause delayed or long-term effects. After a serious exposure, symptoms may worsen for several hours and respiratory effects may persist for hours or days following exposure.

### **What tests can be done if a person has been exposed to methyl mercaptan?**

Methyl mercaptan is normally present in human blood and urine. Detection of abnormally high levels of methyl mercaptan in the blood may be an indication of recent exposure. However, blood tests do not indicate the extent or time of exposure. Specific tests for the presence of methyl mercaptan in the blood or urine are, therefore, not generally useful to the doctor. If a severe exposure has occurred, blood and urine analyses and other tests may show whether the upper respiratory airways and lungs or brain have been injured. Testing is not needed in every case.

### **Where can more information about methyl mercaptan be found?**

More information about methyl mercaptan 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:
  - coughing or wheezing
  - difficulty breathing, shortness of breath, or chest pain
  - increased pain or a discharge from injured eyes
  - increased redness or pain or a pus-like discharge in the area of a skin burn
  - headache, dizziness, or lack of coordination
  
- 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 \_\_\_\_\_