Occupational Health Guideline for Tetraethyl Lead

INTRODUCTION
This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION
- Formula: Pb(C₂H₅)₄
- Synonyms: TEL; lead tetraethyl; motor fuel anti-knock compound
- Appearance and odor: Colorless liquid (or dyed red, orange, or blue) with a slight musty odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)
The current OSHA standard for tetraethyl lead is 0.075 milligrams of tetraethyl lead per cubic meter of air (mg/m³) averaged over an eight-hour work shift. The American Conference of Governmental Industrial Hygienists has recommended that the permissible exposure limit be changed to 0.1 mg/m³. The American Conference of Governmental Industrial Hygienists has recommended for tetraethyl lead a Threshold Limit Value of 0.1 mg/m³ with a skin notation.

HEALTH HAZARD INFORMATION
- Routes of exposure
  Tetraethyl lead can affect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed. It may readily enter the body through the skin.
- Effects of overexposure
  The absorption by humans of a sufficient quantity of tetraethyl lead either briefly at a high rate or for prolonged periods at a lower rate may cause intoxication. The onset of symptoms may be delayed for up to eight days after termination of exposure. The milder toxic effects are difficulty in sleeping, tiredness, wild dreams, anxiety, trembling, spasms, slow heart beat, low body temperature, paleness, nausea and loss of appetite. More severe intoxication causes episodes of disorientation, hallucinations, grimacing, and intense activity which requires that the person be restrained. These episodes may convert into manic or violent convulsive seizures which may end in unconsciousness or death. Tetraethyl lead may cause irritation of the eyes. Fetal damage may occur from exposure of the mother to tetraethyl lead, by analogy to methyl mercury.
- Reporting signs and symptoms
  A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to tetraethyl lead.
- Recommended medical surveillance
  The following medical procedures should be made available to each employee who is exposed to tetraethyl lead at potentially hazardous levels:
  1. Initial Medical Examination:
     - A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a history of mental disorders or hypotension would be expected to be at increased risk from exposure. Examination of the central nervous system and the cardiovascular system should be stressed.
     - Urinalysis: Normal kidney function is considered necessary for biologic monitoring. A urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment. The concentration of lead should be determined. Urine specimens with a specific gravity less than 1.020 should be discarded and another sample obtained.
  2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis, except that the determination of lead in the urine should be repeated quarterly.
- Summary of toxicology
  Tetraethyl lead vapor affects the nervous system and
causes mental aberrations including psychosis, mania, and convulsions. Of 41 female Swiss mice which survived for 36 weeks after a single subcutaneous injection of 0.6 mg, 5 developed malignant lymphomas during the next 15 weeks; the significance of these data cannot be evaluated, because this tumor occurs spontaneously with a variable incidence in the mouse strain used. The absorption by humans of a sufficient quantity of tetraethyl lead, either briefly at a high rate (100 mg/m³ for 1 hour) or for prolonged periods at a lower rate, causes acute intoxication; chronic intoxication has not been observed. The onset of symptoms may be delayed for up to 8 days after termination of exposure. The milder manifestations of intoxication are insomnia, lassitude, lurid dreams, dream-like wakening states of anxiety, tremor, hyperreflexia, spasmodic muscular contractions, bradycardia, hypotension, hypothermia, pallor, nausea, and anorexia. More severe intoxication causes recurrent or nearly continuous episodes of disorientation, hallucinations, facial contortions, and intense hyperactivity which requires that the individual be restrained. Such episodes may convert abruptly into manic or violent convulsive seizures which may terminate in coma and death. During intoxication there is a striking elevation of the rate of excretion of lead in the urine but only a negligible or slight elevation of the concentration of lead in the blood. In severe intoxication, the urine lead is rarely less than 350 μg/l of urine, while the blood lead is rarely more than 50 μg/100 g of blood. There is also a total absence of morphological or chemical abnormalities in the erythrocytes, in sharp contrast to intoxication caused by inorganic lead. In a mortality study of 592 workers, the mean exposure time was 17.9 years, and urinary lead levels during this period did not exceed 180 μg/l; the incidence of death in this group and in a control group of employees was less than that expected in the general population, and there were no peculiarities in the specific causes of death in either group. In a similar study of a different cohort of these exposed workers, there were no significant health differences when compared with a control group. Although tetraethyl lead may be irritating to the eyes, this effect is considered insignificant when compared with the effects on the central nervous system.

CHEMICAL AND PHYSICAL PROPERTIES

- Physical data
  1. Molecular weight: 323.4
  2. Boiling point (760 mm Hg): Decomposes above 100 C (212 F)
  3. Specific gravity (water = 1): 1.65
  4. Vapor density (air = 1 at boiling point of tetraethyl lead): 8.6
  5. Melting point: −138 to −130 C (−216 to −202 F)
  6. Vapor pressure at 20 C (68 F): 0.2 mm Hg
  7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
  8. Evaporation rate (butyl acetate = 1): Data not available

- Reactivity
  1. Conditions contributing to instability: Temperatures above 100 C (212 F) cause decomposition and development of pressure that may cause containers to burst.
  2. Incompatibilities: Contact with strong oxidizers, such as sulfuryl chloride or potassium permanganate, may cause fires and explosions.
  3. Hazardous decomposition products: Toxic airborne substances (such as lead fumes and carbon monoxide) may be released in a fire involving tetraethyl lead.
  4. Special precautions: Tetraethyl lead will attack some forms of plastics, rubber, and coatings.

- Flammability
  1. Flash point: 93 C (200 F) (closed cup)
  2. Autoignition temperature: Data not available
  3. Flammable limits in air, % by volume: Data not available
  4. Extinguishing: Dry chemical, foam, carbon dioxide

- Warning properties
  1. Odor Threshold: No quantitative information is available concerning the odor threshold of tetraethyl lead. The AIHA Hygienic Guide states that this substance "has a characteristic sweetish odor, but the intensity of the odor is not adequate to warn of hazardous concentrations."
  2. Eye Irritation Level: Grant states that "concerning local effects on the eye from direct contact, there was recorded by Leake in 1926 a strange account of a contamination of the eyes from a splash of gasoline containing tetraethyl lead, after which the patient was said to have been unable to see for three-fourths of an hour. In the course of two months the patient was reported improved and was found to have no corneal or ophtalmoscopy abnormality, but was thought to have slight mydriasis, photophobia, and contraction of the visual field. Very likely the initial difficulty in seeing was due to smarting sensation in the eyes and blepharospasm. The evidence of later eye abnormality in this case seems quite indefinite and questionable.

  "I have tested high-test gasoline containing tetraethyl lead by dropping on rabbit eyes, and have found it to cause immediate pain and blepharospasm lasting several minutes. When the application was repeated ten times in the course of five minutes under local anesthesia, it produced conjunctival hyperemia and moderate flocculent discharge, but no damage to cornea or conjunctiva."
  3. Evaluation of Warning Properties: Since there is no quantitative information relating warning properties to air concentrations of tetraethyl lead, this substance is treated as a material with poor warning properties.

MONITORING AND MEASUREMENT PROCEDURES
• General
Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

RESPIRATORS
• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT
• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with undiluted liquid tetraethyl lead or solutions containing more than 1.06 milliliters per liter (4 milliliters per gallon).
• Clothing contaminated with undiluted liquid tetraethyl lead or solutions containing more than 1.06 milliliters per liter (4 milliliters per gallon) should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of tetraethyl lead from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the tetraethyl lead, the person performing the operation should be informed of tetraethyl lead's hazardous properties.
• If employees' clothing has had any possibility of being contaminated with undiluted liquid tetraethyl lead or solutions containing more than 1.06 milliliters per liter (4 milliliters per gallon), employees should change into uncontaminated clothing before leaving the work premises.
• Non-impervious clothing which becomes contaminated with undiluted liquid tetraethyl lead or solutions containing more than 1.06 milliliters per liter (4 milliliters per gallon) should be removed immediately and not reworked until the tetraethyl lead is removed from the clothing.
• Employees should be provided with and required to use splash-proof safety goggles where liquid tetraethyl lead may contact the eyes.

COMMON OPERATIONS AND CONTROLS
The following list includes some common operations in which exposure to tetraethyl lead may occur and control methods which may be effective in each case:

<table>
<thead>
<tr>
<th>Operation</th>
<th>Controls</th>
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<tbody>
<tr>
<td>Liberation during manufacture in preparation of antiknock agents for fuels</td>
<td>Process enclosure; local exhaust ventilation; personal protective equipment</td>
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<tr>
<td>Liberation during formulation at petroleum refinery for use as an antiknock agent</td>
<td>Local exhaust ventilation; total enclosure; personal protective devices</td>
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EMERGENCY FIRST AID PROCEDURES
In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure
If liquid tetraethyl lead or strong concentrations of tetraethyl lead vapors get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• Skin Exposure
If liquid tetraethyl lead or strong concentrations of tetraethyl lead vapors get on the skin, immediately rinse the contaminated skin with kerosene or similar petroleum products, if readily available, then wash the skin using soap or mild detergent and water. If liquid tetraethyl lead or strong concentrations of tetraethyl lead vapors penetrate through the clothing, remove the clothing immediately and first rinse the skin with kerosene or similar petroleum products, if readily available, then wash the skin using soap or mild detergent and water. Get medical attention immediately.

• Breathing
If a person breathes in large amounts of tetraethyl lead, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical
attention as soon as possible.
• **Swallowing**
  When tetraethyl lead has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

• **Rescue**
  Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility’s emergency rescue procedures and know the locations of rescue equipment before the need arises.

### SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If tetraethyl lead is spilled or leaked, the following steps should be taken:
  1. Ventilate area of spill or leak.
  2. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

• Waste disposal methods:
  Tetraethyl lead may be disposed of:
  1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.
  2. By atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

### REFERENCES


# RESPIRATORY PROTECTION FOR TETRAETHYL LEAD

<table>
<thead>
<tr>
<th>Condition</th>
<th>Minimum Respiratory Protection* Required Above 0.075 mg/m³</th>
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<tbody>
<tr>
<td>Vapor Concentration</td>
<td>Any supplied-air respirator. Any self-contained breathing apparatus.</td>
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<tr>
<td>0.75 mg/m³ or less</td>
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<tr>
<td>3.75 mg/m³ or less</td>
<td>Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.</td>
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<tr>
<td>40 mg/m³ or less</td>
<td>A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.</td>
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<tr>
<td>Greater than 40 mg/m³*** or entry and escape from unknown concentrations</td>
<td>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.</td>
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<tr>
<td>Fire Fighting</td>
<td>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.</td>
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<tr>
<td>Escape</td>
<td>Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.</td>
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*Only NIOSH-approved or MSHA-approved equipment should be used.

**Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of tetraethyl lead; however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 40 mg/m³, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.