

Occupational Health Guideline for Tetramethyl 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: $Pb(CH_3)_4$
- Synonyms: TML; lead tetramethyl; 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 tetramethyl lead is 0.075 milligram of tetramethyl lead per cubic meter of air (mg/m^3) averaged over an eight-hour work shift. The American Conference of Governmental Industrial Hygienists has recommended for tetramethyl lead a Threshold Limit Value of $0.150 mg/m^3$ with a skin notation.

HEALTH HAZARD INFORMATION

- **Routes of exposure**
Tetramethyl lead can affect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed. It may enter the body through the skin.
- **Effects of overexposure**
Although there have been no reports of human intoxication from tetramethyl lead exposure, animal experiments suggest that tetramethyl lead may cause toxic effects similar to those produced by tetraethyl lead. Tetraethyl lead exposure effects range from difficulty in sleeping, bad dreams, restlessness, anxiety, nausea, and poor appetite to the more severe symptoms of acute mental disturbance characterized by delirium, violent

behavior, convulsive seizures, unconsciousness, and death. Fetal damage may occur from exposure of the mother to tetramethyl 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 tetramethyl lead.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to tetramethyl 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 of 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 the concentration of lead in the urine should be repeated quarterly.

- **Summary of toxicology**

Tetramethyl lead affects the central nervous system in animals and causes signs of increased irritability. Oral administration of 108 mg/kg to rats caused some deaths; effects were tremors, marked hyperactivity, and convulsions. Tetramethyl lead intoxication in animals resembles that caused by tetraethyl lead (TEL), a close

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

homolog; human intoxication from tetramethyl lead has not been described. A description of human intoxication by TEL is given because of the severity of the effects and the likelihood that intoxication by tetramethyl lead would be similar. TEL effects range from insomnia, bad dreams, restlessness, anxiety, hypotension, nausea, and anorexia to the more severe symptoms of acute mental disturbances characterized by delirium, mania, convulsive seizures, and coma, sometimes followed by death.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 267.3
2. Boiling point (760 mm Hg): 110 C (230 F)
3. Specific gravity (water = 1): 1.99
4. Vapor density (air = 1 at boiling point of tetramethyl lead): 6.5
5. Melting point: -30 C (-22 F)
6. Vapor pressure at 20 C (68 F): 22 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 sulfur chloride or potassium permanganate, may cause fires and explosions.

3. Hazardous decomposition products: Toxic gases and vapors (such as lead fumes and carbon monoxide) may be released in a fire involving tetramethyl lead.

4. Special precautions: Tetramethyl lead will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: 38 C (100 F) (closed cup)
2. Autoignition temperature: Data not available
3. Flammable limits in air, % by volume: Data not available

4. Extinguishant: Dry chemical, foam, carbon dioxide

• Warning properties

1. Odor Threshold: No quantitative information is available concerning the odor threshold of tetramethyl lead.

2. Eye Irritation Level: Tetramethyl lead is not known to be an eye irritant.

3. Evaluation of Warning Properties: Since no quantitative information is available relating warning properties to air concentrations of tetramethyl 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

An analytical method for tetramethyl lead is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 4, 1978, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00317-3).

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 tetramethyl lead or solutions containing more than 1.06 milliliters per liter (4 milliliters per gallon).

• Clothing contaminated with undiluted liquid tetramethyl lead or solutions containing more than 1.06 milliliters per liter (4 milliliters per gallon) of tetramethyl lead should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of tetramethyl lead from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the tetramethyl lead, the person performing the operation should be informed of tetramethyl lead's hazardous properties.

• Where there is any possibility of exposure of an

employee's body to undiluted liquid tetramethyl lead or solution containing more than 1.06 milliliters per liter (4 milliliters per gallon) of tetramethyl lead, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

- Non-impervious clothing which becomes contaminated with undiluted liquid tetramethyl lead or solutions containing more than 1.06 milliliters per liter (4 milliliters per gallon) of tetramethyl lead should be removed immediately and not reworn until the tetramethyl lead is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where liquid tetramethyl lead may contact the eyes.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to tetramethyl lead may occur and control methods which may be effective in each case:

| Operation | Controls |
|---|---|
| Liberation during manufacture in preparation of antiknock fluids | Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment |
| Liberation during formulation at petroleum refinery for use as an antiknock fluid; mixed lead alkyls; as substitutes, in whole or in part, for tetraethyl lead in engine gasoline | Process enclosure; local exhaust ventilation; personal protective equipment |

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 tetramethyl lead or strong concentrations of tetramethyl 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 tetramethyl lead or strong concentrations of tetramethyl 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 tetramethyl lead or strong concentrations of tetramethyl 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 deter-

gent and water. Get medical attention immediately.

• Breathing

If a person breathes in large amounts of tetramethyl 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 tetramethyl 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 tetramethyl lead is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. 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. Tetramethyl lead should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive concentrations of tetramethyl lead vapors are permitted.

- Waste disposal method:

Tetramethyl lead may be disposed of by atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Tetramethyl Lead," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- American Industrial Hygiene Association: "Tetramethyl Lead," *Hygienic Guide Series*, Detroit, Michigan, 1963.
- Baskin, A. D. (ed.): *Handling Guide for Potentially Hazardous Commodities*, Railway Systems and Management Association, Chicago, 1972.
- Castellino, N., et al., "Toxicity of Tetramethyl Lead Solutions to Mice and Rabbits," *British Journal of Industrial Medicine*, 20:63-65, 1963.
- Christensen, H. E., and Luginbyhl, T. L. (eds.): *NIOSH Toxic Substances List*, 1974 Edition, HEW Publication No. 74-134, 1974.
- Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.
- International Labour Office: *Encyclopedia of Occupational Health and Safety*, McGraw-Hill, New York, 1974.
- *Registry of Toxic Effects of Chemical Substances*, U.S. Department of Health, Education, and Welfare, Rockville, Maryland, June 1975.
- Schepers, G. W. H.: "Tetraethyllead and Tetramethyllead - Comparative Experimental Pathology: Part I. Lead Absorption and Pathology," *Archives of Environmental Health*, 8:277-295, 1964.
- Stauden, A. (ex. ed.): *Kirk-Othmer Encyclopedia of Chemical Technology* (2nd ed.), Interscience, New York, 1972.
- deTreville, R. T. P., et al.: "Occupational Exposure to Organic Lead Compounds - The Relative Degree of Hazard in Occupational Exposure to Air-Borne Tetraethyllead and Tetramethyllead," *Archives of Environmental Health*, 5:532-536, 1962.

RESPIRATORY PROTECTION FOR TETRAMETHYL LEAD

| Condition | Minimum Respiratory Protection* Required Above 0.075 mg/m ³ |
|--|---|
| Vapor Concentration | |
| 0.7 mg/m ³ or less | Any supplied-air respirator. Any self-contained breathing apparatus. |
| 3.5 mg/m ³ or less | Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece. |
| 40 mg/m ³ or less | A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode. |
| Greater than 40 mg/m ³ ** or entry and escape from unknown concentrations | 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. |
| Fire Fighting | Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. |
| Escape | Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus. |

*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 tetramethyl 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.