

Occupational Health Guideline for Tellurium and Compounds (as Tellurium)

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.

APPLICABILITY

The general guidelines contained in this document apply to all tellurium and compounds. Physical and chemical properties of several specific compounds are provided for illustrative purposes.

SUBSTANCE IDENTIFICATION

Tellurium

- Formula: Te
- Synonyms: Tellurium, metallic
- Appearance and odor: Odorless, grayish-colored solid with a metallic luster.

Hydrogen telluride

- Formula: H_2Te
- Synonyms: Tellurium hydride
- Appearance and odor: Colorless gas with a characteristic odor like arsenic.

Potassium tellurite

- Formula: K_2TeO_3
- Synonyms: None
- Appearance and odor: White, odorless solid.

Sodium tellurate

- Formula: $Na_2H_4TeO_6$
- Synonyms: Sodium tellurate dihydrate

- Appearance and odor: White, odorless solid.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for tellurium and compounds (as tellurium) is 0.1 milligram of tellurium and compounds (as tellurium) per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

• Routes of exposure

Tellurium and compounds can affect the body if they are inhaled, come in contact with the eyes or skin, or are swallowed. They may enter the body through the skin.

• Effects of overexposure

1. Short-term Exposure: Tellurium, hydrogen telluride, potassium tellurite, or sodium tellurate causes garlic odor of the breath and sweat, dryness of the mouth, metallic taste, sleepiness, loss of appetite, and nausea. Tellurium dioxide exposure may cause a temporary loss of sweat function.

2. Long-term Exposure: Tellurium hydride is highly toxic. It has produced irritation of the lungs and destruction of red blood cells in animals.

3. 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 tellurium and compounds.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to tellurium and compounds at potentially hazardous levels:

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from tellurium and compounds exposure.

—Skin disease: Tellurium can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

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.

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Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

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

—Neurologic disorders: By analogy to effects observed in experimental animals, tellurium may adversely affect the nervous system in man.

—Blood disease: Hydrogen telluride is reported to cause hemolysis in animals. Persons with pre-existing blood disorders may be at increased risk from exposure.

—Chronic respiratory disease: Hydrogen telluride and other gaseous compounds of tellurium are reported to cause pulmonary effects. In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of certain compounds of tellurium might cause exacerbation of symptoms.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination. The concentration of tellurium in the urine may be informative when exposures are high. Garlic odor of the breath is a sensitive sign of tellurium exposure.

• **Summary of toxicology**

Fume or dust of tellurium and its compounds causes garlic odor of the breath and malaise in humans. In animals, acute tellurium intoxication results in restlessness, tremor, diminished reflexes, paralysis, convulsions, somnolence, coma, and death. Tellurium compounds are more toxic than the metal. Administration to pregnant rats of 500 to 3000 ppm tellurium in the diet resulted in high incidence of hydrocephalic offspring. Weaning rats fed elemental tellurium at a level of 1% (10,000 ppm) in the diet developed a neuropathy characterized by segmental demyelination; remyelination and functional recovery occurred despite continued administration of tellurium. Iron foundry workers exposed to concentrations between 0.01 to 0.1 mg/m³ complained of garlic odor of the breath and sweat, dryness of the mouth and metallic taste, somnolence, anorexia, and occasional nausea; urinary concentrations ranged from zero to 0.06 mg/l; somnolence and metallic taste in the mouth did not appear with regularity until the level of tellurium in the urine was at least 0.01 mg/l. Skin lesions in the form of scaly, itching patches and loss of sweat function occurred in workers exposed to tellurium dioxide in an electrolytic lead refinery. Hydrogen telluride is highly toxic and has caused pulmonary irritation and hemolysis of red blood cells in animals; this gas is very unstable, however, and its occurrence as an actual industrial hazard is unlikely.

CHEMICAL AND PHYSICAL PROPERTIES

• **Physical data—Tellurium**

1. Molecular weight: 127.6
2. Boiling point (760 mm Hg): 1390 C (2534 F)
3. Specific gravity (water = 1): 6.24
4. Vapor density (air = 1 at boiling point of tellurium): Not applicable
5. Melting point: 450 C (842 F)
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble

8. Evaporation rate (butyl acetate = 1): Not applicable

• **Physical data—Hydrogen telluride**

1. Molecular weight: 129.6
2. Boiling point (760 mm Hg): -2 C (28 F)
3. Specific gravity (water = 1): 2.6 (liquid)
4. Vapor density (air = 1 at boiling point of hydrogen telluride): 4.5
5. Melting point: -50 C (-58 F)
6. Vapor pressure at 20 C (68 F): 1600 mm Hg approximately
7. Solubility in water, g/100 g water at 20 C (68 F):

Reacts

8. Evaporation rate (butyl acetate = 1): Not applicable

• **Physical data—Potassium tellurite**

1. Molecular weight: 253.8
2. Boiling point (760 mm Hg): Decomposes
3. Specific gravity (water = 1): Data not available
4. Vapor density (air = 1 at boiling point of potassium tellurite): Not applicable
5. Melting point: 450 C (842 F) (decomposes)
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F):

Very soluble

8. Evaporation rate (butyl acetate = 1): Not applicable

• **Physical data—Sodium tellurate**

1. Molecular weight: 273.6
2. Boiling point (760 mm Hg): Decomposes
3. Specific gravity (water = 1): Data not available
4. Vapor density (air = 1 at boiling point of sodium tellurate): Not applicable
5. Melting point: 170 C (338 F) (decomposes)
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F):

0.8

8. Evaporation rate (butyl acetate = 1): Not applicable

• **Reactivity**

1. Conditions contributing to instability: None. (Hydrogen telluride is unstable, but is rarely worked with as such).

2. Incompatibilities: Contact of tellurium metal or hydrogen telluride with strong oxidizers may cause fires and explosions.

3. Hazardous decomposition products: None

4. Special precautions: None

• **Flammability**

1. Flash point: Not applicable
2. Minimum ignition temperature: a) Tellurium: 340 C (644 F) (layer); 550 C (1022 F) (cloud); b) Hydrogen telluride: Data not available; c) Potassium tellurite and d) sodium tellurate: Not applicable
3. Flammable limits in air, % by volume: Tellurium, potassium tellurite, and sodium tellurate: Not applicable; Hydrogen telluride: Data not available
4. Extinguishant: Tellurium: Water; Hydrogen telluride: Rarely handled as such; Potassium tellurite and

sodium tellurate: Not applicable

- **Warning properties**

Tellurium is not known to be an eye irritant.

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**

Sampling and analyses may be performed by collection on a cellulose membrane filter followed by treatment with nitric and perchloric acids, solution in nitric acid, and analysis with an atomic absorption spectrophotometer. An analytical method for tellurium and compounds is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

PB 258 433).

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 the skin from becoming frozen from contact with hydrogen telluride or from contact with vessels containing hydrogen telluride.

- 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 repeated or prolonged skin contact with potassium tellurite, sodium tellurate, or liquids containing these compounds.

- If employees' clothing may have become contaminated with potassium tellurite, sodium tellurate, or liquids containing these compounds, employees should change into uncontaminated clothing before leaving the work premises.

- Clothing contaminated with potassium tellurite or sodium tellurate should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of contaminant from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the contaminant, the person performing the operation should be informed of contaminant's hazardous properties.

- Any clothing which becomes wet with liquid hydrogen telluride should be removed immediately and not reworn until the hydrogen telluride has evaporated.

- Non-impervious clothing which becomes contaminated with potassium tellurite should be removed promptly and not reworn until the potassium tellurite is removed from the clothing.

- Employees should be provided with and required to use splash-proof safety goggles where liquid hydrogen telluride may contact the eyes.

SANITATION

- Skin that becomes contaminated with potassium tellurite should be promptly washed or showered to remove any contaminant.

- Eating and smoking should not be permitted in areas where potassium tellurite, sodium tellurate, or liquids containing these compounds are handled, processed, or stored.

- Employees who handle potassium tellurite, sodium tellurate, or liquids containing these compounds should wash their hands thoroughly with soap or mild detergent and water before eating or smoking.

COMMON OPERATIONS AND CONTROLS

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

Operation

Liberation during recovery, purification, and packaging

Liberation during manufacture of alloys with copper, steel, lead, tin, silver, magnesium, nickel, and phosphorus; during use in manufacture of cast iron; liberation during refining of various minerals

Liberation during use in manufacture of natural and synthetic rubber and plastics

Use in manufacture of tellurium compounds used as insecticides, germicides, fungicides, and photographic print toners

Liberation during use in ceramic colorants and glass manufacture; during manufacture of thermoelectric devices for cooling boxes, solar energy converters, and small control apparatus; during manufacture of electronic devices such as batteries, solar cells, and semiconductors, and during manufacture of tellurium compounds

Liberation during refining of various minerals; during use as a catalyst for acrylic monomer production

Use in manufacture of tellurium compounds used as insecticides, germicides, fungicides, and photographic print toners

Controls

Process enclosure; local exhaust ventilation; personal protective equipment

Process enclosure or local exhaust ventilation; personal protective equipment

Process enclosure or local exhaust ventilation; personal protective equipment

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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 tellurium and compounds get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with these chemicals.

• Skin Exposure

If tellurium and compounds get on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If tellurium and compounds penetrate through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. Get medical attention promptly.

• Breathing

If a person breathes in large amounts of tellurium and compounds, 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 tellurium and compounds have 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 tellurium and compounds are spilled, the following steps should be taken:

1. Ventilate area of spill or leak.
2. Collect spilled material in the most convenient and safe manner and deposit in sealed containers for reclamation or for disposal in a secured sanitary landfill. Liquid containing tellurium and compounds should be absorbed in vermiculite, dry sand, earth, or a similar material.
3. For hydrogen telluride, stop flow of gas.

• Waste disposal method:

Tellurium and compounds may be disposed of in sealed containers in a secured sanitary landfill.

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RESPIRATORY PROTECTION FOR TELLURIUM AND COMPOUNDS (AS TELLURIUM)

Condition	Minimum Respiratory Protection* Required Above 0.1 mg/m ³
Particulate Concentration	
0.5 mg/m ³ or less	Any dust and mist respirator, except single-use.
1 mg/m ³ or less	Any dust and mist respirator, except single-use or quarter-mask respirator. Any fume respirator or high efficiency particulate filter respirator. Any supplied-air respirator. Any self-contained breathing apparatus.
5 mg/m ³ or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
50 mg/m ³ or less	A powered air-purifying respirator with a high efficiency particulate filter. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 50 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 high efficiency particulate filter respirator. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.