# Occupational Health Guideline for Tetryl

## 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: $(NO_2)_3C_6H_2N(NO_2)CH_3$
- Synonyms: 2,4,6-trinitrophenylmethylnitramine; N-methyl-N,2,4,6-tetranitroaniline; nitramine; tetralite
- Appearance and odor: Colorless to yellow, odorless solid.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for tetryl is 1.5 milligrams of tetryl per cubic meter of air ($mg/m^3$) averaged over an eight-hour work shift.

## HEALTH HAZARD INFORMATION

- **Routes of exposure**

Tetryl can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may enter the body through the skin.

- **Effects of overexposure**

Exposure to tetryl may cause irritation of the eyes, nose, and throat. It may stain the skin and hair yellow. It may cause an allergic skin rash. Several days' exposure to high concentrations may cause headaches and nose bleeding. Occasionally, coughing and choking occur. Severe prolonged exposure may cause insomnia, nausea, vomiting, irritability, and anemia. In animals, it has caused liver and kidney damage, and severe breathing difficulties which may be delayed in onset.

- **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 tetryl.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to tetryl 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 asthma, allergies, or known sensitization to tetryl may be at increased risk from exposure. Examination of the respiratory tract, eyes, liver, central nervous system, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

—A complete blood count: Tetryl has been shown to cause anemia in humans. A complete blood count should be performed including a red cell count, a white cell count, a differential count of a stained smear, as well as hemoglobin and hematocrit.

*2. Periodic Medical Examination:* The aforementioned medical examinations should be repeated on an annual basis.

- **Summary of toxicology**

Tetryl dust causes severe sensitization dermatitis and irritation of the upper respiratory tract. Dogs injected subcutaneously with fatal doses showed degeneration of renal tubules, liver necrosis, and occasional pulmonary edema. Dermatitis in workers appears as early as the first week of exposure to the dust with itching of the eyes; there is a progression to erythema and edema occurring most often on the nasal folds, cheeks, and neck; papules and vesicles may develop; the remainder of the body is rarely affected. The severest forms show massive generalized edema with partial obstruction of the trachea due to swelling of the tongue and require

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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hospitalization; exfoliation usually occurs after the edema subsides. The majority of these effects occur between the 10th and 20th days of exposure; upon cessation of exposure there is rapid abatement of the mild symptoms, and after 3 to 10 days disappearance of physical signs. Contact with tetryl causes a bright yellow staining, most often seen on the palms, face, neck, and in the hair. The irritant effects on the upper respiratory tract range from the nares to the bronchi and cause burning, itching, sneezing, coryza, epistaxis, and cough; the symptoms may begin the first day of exposure or as late as the third month; upon removal from exposure the symptoms regress over 2 to 4 weeks. Other effects reported in tetryl workers are irritability, easy fatigability, malaise, headache, lassitude, insomnia, nausea, and vomiting. Anemia, either of the marrow depression or deficiency type, has been observed among tetryl workers. Conjunctivitis may be caused by rubbing the eyes with contaminated hands or by airborne dust; keratitis and iridocyclitis have occurred.

## CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 287
2. Boiling point (760 mm Hg): 187 C (369 F) (explodes)
3. Specific gravity (water = 1): 1.6– 1.7
4. Vapor density (air = 1 at boiling point of tetryl): Not applicable
5. Melting point: 129 C (264 F)
6. Vapor pressure at 20 C (68 F): Much less than 1
7. Solubility in water, g/100 g water at 20 C (68 F): 0.02
8. Evaporation rate (butyl acetate = 1): Not applicable

- **Reactivity**

1. Conditions contributing to instability: Heat and shock
2. Incompatibilities: Contact of tetryl with some oxidizable materials may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen and carbon monoxide) may be released in a fire involving tetryl.
4. Special precautions: Protect from shock

- **Flammability**

1. Flash point: Explodes
2. Flammable limits in air, % by volume: Not applicable
3. Impact sensitivity (minimum fall of a 2 kg weight to cause at least one explosion in ten trials): 26 cm
4. Explosion temperature (temperature required to cause explosion in five seconds): 257 C (495 F)
5. Extinguishant: Water may be used on small fires. Do not attempt to extinguish large fires.

- **Warning properties**

Concerning the effects of tetryl on the eye, Grant states that "conjunctivitis may be caused by rubbing the eyes with contaminated hands, but more commonly airborne dust is responsible. Conjunctivitis is usually accompanied by dermatitis of the face, but may persist considerably longer than the skin rash. Keratitis and iridocyclitis are also said to have occurred in association with the conjunctivitis." No quantitative information is available concerning what concentrations in air produce the conjunctivitis, however.

## 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 of tetryl on a cellulose membrane filter with subsequent extraction with N,N-diethylethanolamine and spectrophotometric analysis. An analytical method for tetryl 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).

## 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 repeated or prolonged skin contact with tetryl or liquids containing tetryl.

• If employees' clothing may have become contaminated with tetryl, employees should change into uncontaminated clothing before leaving the work premises.

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

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

• Employees should be provided with and required to use splash-proof safety goggles where tetryl or liquids containing tetryl may contact the eyes.

## SANITATION

• Workers subject to skin contact with tetryl should wash any areas of the body which may have contacted tetryl at the end of each work day.

• Skin that becomes contaminated with tetryl should be promptly washed or showered with soap or mild detergent and water to remove any tetryl.

• Eating and smoking should not be permitted in areas where tetryl is handled, processed, or stored.

• Employees who handle tetryl or liquids containing tetryl should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

## COMMON OPERATIONS AND CONTROLS

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

| Operation | Controls |
|---|---|
| Use in the manufacture of explosives for use in blasting caps, boosters in high explosive shells, aircraft cannons, shells, and as a primer for less sensitive explosives; use during the formulation of binary explosives | Process enclosure; local exhaust ventilation; personal protective equipment |
| Use as a pH indicator | 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 tetryl or liquids containing tetryl 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 immediately. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

If tetryl or liquids containing tetryl get on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If tetryl or liquids containing tetryl 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 tetryl, 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 tetryl or liquids containing tetryl 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 AND DISPOSAL PROCEDURES

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

• If tetryl is spilled, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill.
3. Attempt to reclaim spilled material; however, do not sweep or burn unless this is supervised by explosives experts.

• Waste disposal method:

Tetryl may be disposed of only by explosives experts.

## REFERENCES


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## RESPIRATORY PROTECTION FOR TETRYL

| Condition | Minimum Respiratory Protection* Required Above 1.5 mg/m³ |
|---|---|
| Particulate Concentration | |
| 7.5 mg/m³ or less | Any dust and mist respirator, except single-use.** |
| 15 mg/m³ or less | Any dust and mist respirator, except single-use respirator or quarter mask.**<br>Any fume respirator or high efficiency particulate filter respirator.**<br>Any supplied-air respirator.**<br>Any self-contained breathing apparatus.** |
| 75 mg/m³ or less | A high efficiency particulate filter respirator with a full facepiece.<br>Any supplied-air respirator with a full facepiece, helmet, or hood.<br>Any self-contained breathing apparatus with a full facepiece. |
| 1500 mg/m³ or less | A powered air-purifying respirator with a full facepiece and a high efficiency particulate filter. |
| 3000 mg/m³ or less | A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode. |
| Greater than 3000 mg/m³ or entry and escape from unknown concentrations | Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.<br>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 dust and mist respirator, except single-use.<br>Any escape self-contained breathing apparatus. |

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

**If eye irritation occurs, full-facepiece respiratory protective equipment should be used.