

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** TETRYL ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for TETRYL

The basic text of this document contains the draft technical standard approved by the Joint Review Committee of the NIOSH/OSHA Standards Completion Program and the supporting documentation for the substance TETRYL.

The SCP draft technical standards are recommendations to the Department of Labor for its consideration in rulemaking and have no legal status until final rules have been promulgated by that agency. This draft standard is provided for your information only.

The References and Sources, Respirator Table Documentation and Use/Exposure and Control Documentation are the working documents used by the various SCP working groups during the development of the draft technical standard and serve as the technical foundation for the standard. The classification for each substance and the regulatory statements were derived following a decision logic established for the various sections of the standard.

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(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of tetryl not in excess of 1.5 milligram per cubic meter, (mg/M3) averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z-1.

(2) "Action level" means one half of the permissible exposure for tetryl.

(b) Exposure determination and measurement. (1) Each employer who has a place of employment in which tetryl is present shall determine if any employee may be exposed to airborne concentrations of tetryl at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of tetryl.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to tetryl;

(ii) Any measurements of tetryl taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to tetryl; and

(IV) Date of determination, work being performed at the time, location within work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to tetryl at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b) (3) of this section reveals employee exposure to tetryl at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to tetryl at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to tetryl above the permissible exposure, the employer shall:

(i) Measure the exposure monthly of the employee so exposed; and

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to tetryl above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to tetryl below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph, employee exposure is that which would occur if the employee were not using a respirator.

(c) Methods of measurement. (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the

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employee's actual exposure averaged over an eight-hour work shift (See Appendix B (IV) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

Table 1

Concentration	Required Accuracy
Above permissible exposure	$\pm 25\%$
At or below permissible exposure and above the action level	$\pm 35\%$

At or below the action level $\pm 50\%$

(d) Compliance. (1) No employee shall be exposed to tetryl above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of tetryl shall be controlled to at or below the permissible exposure by engineering and work practice controls.

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity or static pressure, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of tetryl.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of tetryl to at or below the permissible exposure; or

(iv) For operations which require entry into tanks or closed vessels; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses

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the respirator provided. When an employee informs his employer that he is experiencing eye irritation from tetryl while wearing a respirator allowed in Table 2, the employer shall provide and ensure that the employee use an equivalent respirator with a full facepiece, helmet or hood.

TABLE 2 RESPIRATORY PROTECTION FOR TETRYL

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
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.
	Any fume respirator or high efficiency particulate filter respirator.
	Any supplied-air respirator.
	Any self-contained breathing apparatus.
75 mg/M3 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.
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.
	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

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operated in pressure-demand or other positive pressure mode.

Escape Any dust and mist respirator, except single use.

Any escape self-contained breathing apparatus.

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e), and (f).

(e) Fire and safety. (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for tetryl.

(2) Sources of ignition such as smoking or open flames are prohibited where tetryl is handled, used or stored.

(3) Tetryl shall be stored so as not to come in contact with oxidizable materials.

(4) For the purposes of compliance with §1910.109, tetryl shall be classified as a Class A explosive.

(f) Personal protective equipment. (1) Employers shall provide and ensure that employees use appropriate protective clothing necessary to prevent repeated or prolonged skin contact with solid tetryl or liquids containing tetryl. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that employees whose clothing may have become contaminated with solid tetryl change into uncontaminated clothing before leaving the work premises.

(3) Employers shall ensure that clothing contaminated with tetryl is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of tetryl from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the tetryl, the employer shall inform the person performing the operation of the hazardous properties of tetryl.

(4) Employers shall ensure that non-impervious clothing which becomes contaminated with tetryl be removed promptly and not reworn until the tetryl is removed from the clothing.

(5) Employers shall provide and ensure that employees use safety goggles which comply with § 1910.133(a)(2)-(a)(6) where solid tetryl or liquids containing tetryl may contact the eyes.

(g) Spills and disposal. In the event that tetryl is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation, and then clean up the spill.

(h) Sanitation. (1) Employers shall ensure that all employees subject to skin contact with solid tetryl wash any areas of the body which may have contacted tetryl at the end of each work day.

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(2) Employers shall ensure that employees whose skin becomes contaminated with tetryl promptly wash or shower with soap or mild detergent and water to remove any tetryl from the skin.

(3) Employers shall ensure that employees do not eat or smoke in areas where solid tetryl is handled, processed or stored.

(4) Employers shall ensure that employees who handle solid tetryl or liquids containing tetryl wash their hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.

(i) Training and information. (1) Each employer who has a workplace in which tetryl is present shall keep a copy of this regulation with Appendixes A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees where tetryl is present, shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for tetryl (Appendix A of this section);

(ii) Advise affected employees as to the signs and symptoms of exposure to tetryl.

(iii) Instruct affected employees to advise the employer of the development of signs and symptoms of overexposure to tetryl which are listed in Appendix A of the section; and

(iv) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to tetryl.

(j) Medical surveillance. (1) The employer shall provide procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) Preplacement medical examinations. The employer shall make available to each employee who is exposed, or will be exposed, to tetryl or liquids containing tetryl or airborne concentrations of tetryl at or above the action level, without regard to the use of respirators, a preplacement medical examination which must include the following:

(i) A medical history and physical examination with emphasis on the lungs, eyes, liver, central nervous system, kidneys and skin;

(ii) A complete blood count to include at least red and white cell count, a differential smear, hemoglobin and hematocrit.

(3) Periodic medical examination. The employer shall make available to each employee exposed to tetryl or liquids containing tetryl or airborne concentrations of tetryl at or above the action level, without regard to the use of respirators, twelve months from the date of the employee's first exposure, and every twelve months thereafter, a periodic medical examination which must include the following:

(i) A medical history and physical examination with emphasis on the lungs, eyes, liver, central nervous system, kidneys and skin;

(ii) A complete blood count to include at least red and white cell count, a differential smear, hemoglobin and hematocrit.

(4) Alternative medical procedures. If the examining physician chooses to use alternative medical specified in paragraphs (j)(2) and (j)(3) of this section, the employer may accept such alternative medical procedures as meeting the requirements of this section provided that the employer:

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(i) Obtains a statement from the examining physician setting forth the alternative medical procedures, the rationale for substitution, and evidence that they will be equally effective:

(ii) Informs each exposed worker of the fact that alternative medical procedures to those required in paragraphs (j)(2) and (j)(3) of this section are to be made available.

(5) Interim medical examination. The employer shall provide an interim medical examination for the employee if the employee informs the employer of any of the signs or symptoms of exposure to tetryl which are listed in Appendix A which the employee suspects are caused by exposure to tetryl.

(6) Informing the physician. The employer shall provide to the physician performing any medical examination required by this section the following information:

(i) A copy of this regulation with Appendixes A, B, and C for tetryl:

(ii) A description of the affected employee's duties as they relate to his exposure to tetryl;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(7) Where a medical examination is required by paragraphs (j)(2), (j)(3), or (j)(5) of this section, following such examination the employer shall obtain from the examining physician a written opinion which conforms with paragraph (j)(8) of this section.

(8) Physician's written opinion. i) the physician's written opinion by the examining physician shall specifically state:

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to tetryl;

(B) Any recommended limitations upon the employee's exposure to tetryl, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to the employee's employment.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(9) Results of tests. Where a preplacement or periodic medical examination is required by paragraphs (j)(2) or (j)(3) of this section, following such examination the employer shall obtain from the examining physician for inclusion in the employee's medical record:

(i) A recording of the results of the blood count;

(ii) Where alternative medical procedures have been performed in accordance with paragraph (j)(4) of this section, a recording of such alternative procedures.

(10) No employee shall be exposed to tetryl in such a way as would put the employee at increased risk of material impairment of his health from

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such exposure. The employer shall base this decision on any information available, including the physician's written opinion.

(11) No medical procedure which would be performed pursuant to paragraphs (j)(2) or (j)(3) of this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(12) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(13) The employer shall provide emergency medical treatment for any employee injured through exposure to tetryl.

(k) Recordkeeping. (1) Exposure determination. (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) This record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) Exposure measurements. (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to tetryl.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to tetryl which are being monitored;

(C) Sampling and analytical method used and evidence of their accuracy;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) Mechanical ventilation. (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken;

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) Employee training and information. (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained;

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) Medical surveillance. (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) The name and social security number of the employee;

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(B) Results of tests required by paragraph (j)(2) and (j)(3) of this section and results of any tests conducted pursuant to paragraphs (j)(4) of this section;

(C) Any employee medical complaints relative to exposure to tetryl;

(D) A copy of information provided to the physician pursuant to paragraph (j)(6)(ii), (iii), (iv), (v), and (vi) of this section.

(E) Physician's written opinion; and

(F) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of and for five years after termination of the employment of the affected employee.

(6) Access to records. (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Each employee or former employee shall have access to the exposure determination and exposure measurement records required to be maintained by this section which indicate his own exposure to tetryl.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(1) Employee observation of measurement. (1) The employer shall give each employee or his representative an opportunity to observe any measurement of his exposure to tetryl which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to tetryl requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure.

(ii) Visually observe all steps related to the measurement of the airborne concentration of tetryl that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE: The information contained in the following appendix for tetryl is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligation. To the extent that the information supplements this regulation for tetryl, it is advisory in nature.

APPENDIX A

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SUBSTANCE SAFETY DATA SHEET
FOR TETRYL

I. SUBSTANCE IDENTIFICATION

- A. Substance: Tetryl (2,4,6-Trinitrophenylmethylnitramine)
- B. Permissible Exposure: 1.5 milligrams of tetryl per cubic meter of air (mg/M3) averaged over an eight-hour work shift.
- C. Appearance and Odor: Colorless to yellow odorless solid

II. HEALTH HAZARD DATA

- A. Ways in which the chemical affects your body: Tetryl dust can affect your body if you inhale it or if it comes in contact with your eyes or skin or if you swallow it. It may enter your body through your skin.
- B. Effects of Overexposure:
 - 1. 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 day's 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.
 - 2. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by exposure to tetryl.

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If tetryl or liquids containing tetryl get into your eyes, wash your 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.
- B. Skin Exposure: If tetryl or liquids containing tetryl get on your skin, promptly wash the contaminated skin using soap or mild detergent and water. If tetryl or liquids containing tetryl penetrate through your clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. Get medical attention promptly.
- C. Breathing: If you or any other 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.
- D. 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.
- E. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else

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and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of emergency rescue equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

- A. Respirators: Respirators are not the best way to control exposure to tetryl. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where there use is required. If you experience difficulty breathing while wearing a respirator, tell your employer.
- B. Protective Clothing: You must wear appropriate protective clothing and equipment to prevent repeated or prolonged skin contact with solid tetryl or liquids containing tetryl. Replace or repair impervious clothing that has developed leaks.
- C. Eye Protection: You must wear splash-proof safety goggles where liquids containing tetryl may contact your eyes. You must wear dust-resistant safety goggles where solid tetryl may contact your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. Tetryl is a combustible, highly explosive solid which may detonate when heated in a fire or subject to shock.
- B. Tetryl must be stored in accordance with CFR 1910.109 away from heat and some oxidizable materials.
- C. Sources of ignition such as smoking and open flames are prohibited wherever tetryl is handled, used or stored.
- D. If your work clothing may have become contaminated with solid tetryl, you must change into uncontaminated clothing before leaving the work premises.
- E. You must promptly remove any non-impervious clothing that becomes contaminated with tetryl and this clothing must not be reworn until the tetryl is removed from the clothing.
- F. If your skin becomes contaminated with tetryl, you must promptly wash or shower with soap or mild detergent and water to remove the tetryl from your skin.
- G. If you are subject to skin contact with tetryl, at the end of each work day you must wash any areas of your body with soap or mild detergent and water that may have contacted tetryl.
- H. You must not eat or smoke in areas where tetryl is handled, processed or stored.
- I. If you handle tetryl or liquids containing tetryl, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.

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- J. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them.
 - K. Ask your supervisor where tetryl is used in your work area and for any additional safety and health rules.
- VI. ACCESS TO INFORMATION
- A. Each year your employer is required to inform you of the information contained in this Substance Safety Data Sheet for tetryl. In addition, your employer must instruct you in the safe use of tetryl, emergency procedures, and the correct use of protective equipment.
 - B. Your employer is required to determine whether you are being exposed to tetryl. You or your representative have the right to observe employee exposure measurements and to record the results obtained. If your employer determines that you are being overexposed, he is required to inform you of the exposure and the actions which are being taken to reduce your exposure.
 - C. Your employer is required to keep records of your exposure and medical examinations. Your employer is required to keep exposure data for at least one year and to keep medical data during your employment, and for a period of five years following your termination of employment. Your employer is required to make the exposure data available to you upon your request. Your employer is also required to release your medical records to your physician upon your written request.
 - D. Your employer must give you a copy of the physicians written opinion for any physical examination required by this standard.

NOTE: The information contained in the following appendix for tetryl is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligation. To the extent that the information supplements this regulation for tetryl, it is advisory in nature.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
FOR TETRYL

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

- 1. Synonyms: 2,4,6-trinitrophenylmethylnitramine;
N-methyl-N,2,4,6-tetranitroaniline; Nitramine; Tetralite
- 2. Formula: $(\text{NO}_2)_3\text{C}_6\text{H}_2\text{N}(\text{NO}_2)\text{CH}_3$
- 3. Molecular weight: 287

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B. Physical Data

1. Boiling point (760 mm Hg): 187 C (369 F) (explodes)
2. Specific gravity (water = 1): 1.6 - 1.7
3. Vapor density (air = 1 at boiling point of tetryl): Not applicable
4. Melting point: 129 C (264 F)
5. Vapor pressure at 20 C (68 F): Much less than 1
6. Solubility in water, % by weight at 20 C (68 F): 0.02
7. Evaporation rate (butyl acetate = 1): Not applicable
8. Appearance and odor: Colorless to yellow, odorless solid

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: Explodes
2. Flammable limits in air, % by volume: Not applicable
3. Impact sensitivity (minimum fall of a 2kg 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. Extinguishing media: Water may be used on small fires. Do not attempt to extinguish large fires.
6. Special fire-fighting procedures: Do not use a solid stream of water since a stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire. Fires involving tetryl should be fought from an explosion-resistant location because of the possibility of detonation of tetryl. In advanced or massive fires, the area should be evacuated.
7. Unusual fire and explosion hazards: Tetryl is an explosive solid. Tetryl may be detonated when heated or subjected to shock. It is more sensitive to shock and friction than TNT. All ignition sources must be controlled where tetryl is used, handled or stored.
8. For purposes of conforming with the requirements of 29 CFR 1910.109, tetryl is classified as a Class A explosive.

B. Reactivity

1. Conditions contributing to instability: Heat and shock.
2. Incompatibilities: Contact of tetryl with some oxidizable materials may cause fires and explosion.
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.

III. SPILL AND DISPOSAL PROCEDURES

A. 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.

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

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- C. Waste disposal methods: Tetryl may be disposed of only by explosives experts.

IV. MONITORING AND MEASUREMENT PROCEDURES

- A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the eight-hour exposure may be determined from a single eight-hour sample or 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 (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR part 84, portable direct-reading instruments, dosimeters, or by collection of particulates using a high efficiency membrane filter with subsequent chemical analysis. The method of measurement must determine the concentration of tetryl to plus or minus 35%.
- B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring and measurements under this section should be essentially the same as described above. More than three (3) measurements should be taken during the work shift so that increased confidence may be placed in the judgement that the employee has or has not, in fact, been exposed in excess of the permissible limit. Samples should be collected as described in paragraph IV. A. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association. The method of measurement must determine the concentration of tetryl to plus or minus 25%.
- C. METHODS: Methods meeting these accuracy requirements are available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161 under the title "NIOSH Analytical Methods for Set 2" (Order number XXXXXXXXXX).
- D. QUALIFIED PERSONS: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

- A. Store tetryl in accordance with CFR 1910.109 protected from impact by suitable barriers.
- B. Soap with 10 per cent potassium sulfite will turn red in contact with tetryl and can be used as an indication of the effectiveness of removal of tetryl from the skin.
- C. Employers should advise employees of all areas and operations where their exposure to tetryl could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to tetryl is likely to occur are: During its production and use as a booster component in

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military high explosives or as a component in some binary explosive systems; and during its use as a pH indicator.

NOTE: The information contained in the following appendix is neither intended, by itself, to create any additional obligations nor otherwise impose or detract from any existing obligations and to the extent the information supplements this regulation for tetryl, it is advisory in nature.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. 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 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.

III. SIGNS AND SYMPTOMS

Sensitization dermatitis including itching, erythema, and edema on nasal folds, cheeks, and neck; keratitis, iridocyclitis; epistaxis, sneezing, cough, coryza; irritability, easy fatigability, malaise, headache, lassitude, insomnia, nausea, vomiting; anemia; by analogy to effects

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caused in animals, it may cause liver and kidney damage and pulmonary edema.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Immediately flush eyes with water and wash skin with soap or mild detergent and water. Soap with 10 percent potassium sulfite will turn red in contact with tetryl and can be used as an indication of the effectiveness of removal of tetryl from the skin. If swallowed and the person is conscious, induce vomiting. Give artificial resuscitation and administer oxygen if indicated.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of tetryl are caused by its capability to produce sensitization dermatitis and irritation of the upper respiratory tract. Skin absorption is known to occur. It is important that the physician become familiar with plant operating conditions in which exposure to tetryl occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. PREPLACEMENT

The following medical procedures must be made available to each employee who is exposed to tetryl:

1. A complete history and physical examination -- The purpose is to detect preexisting 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.
2. A complete blood count -- Tetryl has been shown to cause anemia in humans. A complete blood count must be performed including a red cell count, a white cell count, a differential count of a stained smear, as well as hemoglobin and hematocrit.

C. PERIODIC EXAMINATIONS

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The above medical examinations are to be repeated on an annual basis.

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Tetryl," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 255.
2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 2123, 2151-2152.
3. International Labour Office: Encyclopaedia of Occupational Health and Safety, Vol II, L-Z, McGraw Hill Book Company, New York, 1974, pp. 1397-1398.
4. Bergman, B.B.: "Tetryl Toxicity: A Summary of Ten Years' Experience," A.M.A. Archives of Industrial Hygiene and Occupational Medicine, 5:10-20, 1952.
5. Hardy, H.L. and C.C. Maloof: "Evidence of Systemic Effect of Tetryl, With Summary of Available Literature," A.M.A. Archives of Industrial Hygiene and Occupational Medicine, 1:545-555, 1950.
6. Troup, H.B.: "Clinical Effects of Tetryl (CE Powder)," British Journal of Industrial Medicine, 3:20-21, 23, 1946.
7. Schwartz, L.: "Dermatitis from Explosives," Journal of the American Medical Association, 125:186-190, 1944.
8. Hilton, J. and C.N. Swanston: "Clinical Manifestations of Tetryl and Trinitrotoluene," British Medical Journal, 2:509-510, 1941.
9. von Oettingen, W.F.: The Aromatic Amino and Nitro Compounds, Their Toxicity and Potential Dangers, A Review of the Literature, Public Health Bulletin No. 271, U.S. Public Health Service, U.S. Government Printing Office, Washington, D.C., 1941.

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REFERENCES AND SOURCES

TETRYL

1910.1000

- (f) Personal Protective Equipment, and, (h) Sanitation
- Eye: Sax, "Dangerous Properties of Industrial Materials;" Grant, "Toxicology of the Eye;" International Labour Office, "Encyclopedia of Occupational Health and Safety"
- Skin: Sax, "Dangerous Properties of Industrial Materials;" American Conference of Governmental Industrial Hygienists, "Documentation of the Threshold Limit Values for Substances in Workroom Air;" Patty, "Industrial Hygiene and Toxicology;" Hunter, "The Diseases of Occupations;" International Labour Office, "Encyclopedia of Occupational Health and Safety"
- Ingestion: Sax, "Dangerous Properties of Industrial Materials;" American Conference of Governmental Industrial Hygienists, "Documentation of the Threshold Limit Values for Substances in Workroom Air;" International Labour Office, "Encyclopedia of Occupational Health and Safety;" Patty, "Industrial Hygiene and Toxicology"

COMMENTS

Eye - Classifications: 2 and 6

Output statement numbers: 10 and 12 combined

Exceptions: None

Sax notes that conjunctivitis may result from "rubbing the eyes with contaminated hands or through exposure of air-borne dust. Iridocyclitis and keratitis have developed as a sequel to the conjunctivitis." Grant reiterates what is said by Sax, and adds that "sensitization - type dermatitis . . . may involve the eyelids," and that conjunctivitis may persist considerably longer than a skin rash.

The ILO states that severe initial exposure affects the conjunctivae and is "nearly always bloodshot."

Since there is no indication that the substance produces permanent injury, classifications of 2 and 6 are concluded to be appropriate.

Skin - Classifications: 2 and 6

Output statement numbers: 2, 5b, 7a, 15, 17g, 17i, 20a

Exceptions: 15 added

According to Sax, "the chief effect produced by exposure to tetryl is the development of dermatitis." He rates it as of moderately toxic hazard as an acute and chronic local irritant, and also reports that it "can be absorbed through intact skin."

The ACGIH notes that "Probst, et al., reported that their most common finding in persons working with tetryl was contact dermatitis and dermal sensitization." Patty agrees, further adding, that "as an industrial hazard, . . . it is of a very minor significance," the "most troublesome effects . . . , is (sic) a yellow staining of the skin and hair, which cosmetically and psychologically disturbs many individuals.

Hunter details the signs and symptoms of tetryl poisoning by saying, "tetryl causes yellow staining of the hands of

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workers in from one to three days and of the face, neck, scalp and hair in from one to three weeks. The colour deepens to orange on exposure to sunlight." Hunter further notes that the most common complaint is dermatitis, generally affecting the "face first. Later the condition spreads to the chin, neck and back of the head, causing severe irritation. In some cases . . . gross oedema of the eyelids . . . may prevent the patient from opening the eyes for two or three days. Mild cases clear up in a few days, but in severe cases the rash often persists for two or three weeks."

According to the ILO, "workers who can continue to work in spite of the dermatitis develop a tolerance for . . . tetryl. However, with severe exposure, or in subjects with poor personal hygiene or very fair skin, the dermatitis may spread to other parts of the body and become papular, vesicular and eczematous."

Tetryl has a vapor pressure of much less than 1 mm Hg at 20 degrees C, and is 0.02% soluble in water.

Classifications of 2 and 6 are concluded to be sufficient if statement 15 is specified to ensure that prolonged contact with small amounts does not occur. To be noted is that the ACGIH reports that a concentration in air of 1.5 mg/M3 appears sufficient to prevent systemic poisoning but not sensitization.

Ingestion - Classifications: 2 and 6

Output statement numbers: 19, 20a

Exceptions: None

Sax reports that "tetryl workers may develop gastrointestinal symptoms, though these complaints are more common among TNT workers. Anemia has been reported to occur frequently."

The ACGIH notes that a study has indicated "irreversible liver damage," however, Bergman "has reviewed the controversial question of liver and kidney damage," and "reported on ten year's (sic) experience . . . no case of systemic poisoning was encountered."

According to the ILO, "following severe, prolonged exposure, tetryl causes chronic poisoning with digestive disorders such as loss of appetite, abdominal pain, vomiting and loss of weight, a chronic hepatitis, central nervous system irritation with insomnia, exaggerated reflexes, and mental excitation. Cases of leucocytosis with occasional slight anaemia have been reported. Animal experiments indicate renal tubule damage."

Patty notes that "systemic toxicity has never been recognized from this compound."

Classifications of 2 and 6 are concluded to be sufficient to prevent any local or systemic effects from ingestion.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

National Fire Protection Association, "Fire Protection Guide on Hazardous Materials," 5th edition, 1975 (NFPA)

Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 8,

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p. 619 (K-O)

Gessner and Hawley, "Condensed Chemical Dictionary," 8th edition,
1971 (chem Dict)

Baskin, A.D. - Handling Guide for Potentially Hazardous Commodities (Baskin)

Sources of data items used:

- I. A. 1. Synonyms: K-O
2. Formula: K-O
3. Molecular weight: ADL
- B. 1. Boiling point: K-O; Chem Dict
2. Specific gravity: K-O
3. Vapor density: Not applicable
4. Melting point: K-O
5. Vapor pressure: ADL
6. Solubility in water: K-O
7. Evaporation rate: Not applicable
8. Appearance and odor: K-O
- II. A. 1. Flash point: Not available
2. Autoignition temperature: Chem Dict
3. Flammable limits: K-O
4. Extinguishing media: K-O, ADL
5. Special fire fighting procedures: K-O, ADL
6. Unusual fire and explosion hazards: K-O
- B. 1. Condition contributing to instability: K-O
2. Incompatibilities: NFPA-491M
3. Hazardous decomposition products: K-O
4. Special precautions: ADL
- III. A. Steps if released or spilled: Baskin
C. Waste disposal method: Baskin
- V. Miscellaneous precautions: K-O

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

Bergman, B. B., "Tetryl Toxicity: A Summary of Ten Years' Experience,"
Industrial Hygiene and Occupational Medicine, 5, p. 10 - 20, 1952
(Bergman)

International Labour Office, "Encyclopedia of Occupational Health and
Safety," 1972 (ILO)

Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience
Publishers, 2nd edition, 1972 (K-O)

"Merck Index of Chemicals and Drugs," Merck and Co., Inc., 8th edition,
1968 (Merck)

Schwartz, L., Tulipan, L. and Birmingham, D. J., "Occupational Diseases
of the Skin," Lea and Febiger (Schwartz)

Shreve, R. N., "Chemical Process Industries," McGraw Hill, 1956 (Shreve)

References for Specific Use/Exposures

- 1. ILO, Shreve
- 2. K-O
- 3. Bergman
- 4. Merck

References for Specific Control Methods

Bergman, ILO and Schwartz were the references used in all the Specific
Control Methods.

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RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Tetryl

D. O. L. STANDARD: 1.5 mg/M3

Eye Irritation Level: 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. Therefore, half facepiece respirators are permitted up to a concentration of 75.0 mg/m3. If eye irritation occurs, however, full facepiece respirators must be worn.

IDLH: There is no evidence in the available toxicological information that an acute exposure to a high concentration of tetryl would impede escape or cause any irreversible health effects within one-half hour. For the purposes of this standard, therefore, respirators have been assigned on the basis of the protection factor afforded by each device.

Other Toxicological Information: The ILO states that "on initial exposure, tetryl produces acute irritation of the nasal and pharyngeal mucous membranes. Within a few days, the hands, face, scalp and hair of exposed workers are stained a yellowish colour. Under severe exposure, the conjunctivae are affected and nearly always bloodshot; palpebral and periorbital oedema is not uncommon.

"During the first 2 - 3 weeks of exposure, workers may develop a dermatitis in the form of erythema, particularly in the region of the neck, chest, back and the inside surface of the forearms. . .

"After only 3 - 4 days of exposure to high dust concentrations, workers may complain of headaches followed by periodic nosebleeding. Upper respiratory tract irritation does not frequently extend to the bronchi because, due to their large size, tetryl crystals do not usually reach this far; however, dry cough and bronchial spasms have been observed. Diarrhoea and menstrual disorders may occur occasionally.

"Many of the disorders caused by tetryl are to be attributed to the irritant action of the crystals. In some cases, the dermatitis is allergic; in many cases, mechanisms such as local histamine liberation have been suggested.

"Following severe, prolonged exposure, tetryl causes chronic poisoning with digestive disorders such as loss of appetite, abdominal pain, vomiting, loss of weight, a chronic hepatitis, central nervous system irritation with insomnia, exaggerated reflexes, and mental excitation. Cases of leucocytosis with occasional slight anaemia have been reported. Animal experiments indicate renal tubule damage."

According to the Documentation of TLV's, Probst et al. reported that their most common finding in persons working with tetryl was contact dermatitis and dermal sensitization. There was no evidence of

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systemic illness from tetryl under their control procedures. No air concentrations of tetryl were reported. Hardy and Maloof reported effects from accidental exposures of eleven persons to tetryl; two died, one had a disability and eight did not have a detected permanent disability. From these studies they suggested that irreversible liver damage, dermatitis, and upper respiratory irritation were effects of tetryl exposure; in addition, one worker developed pulmonary pathologic changes, presumably attributable to exposure to tetryl.

"Bergman described the effects of tetryl exposure in some detail including the epidermal effects, respiratory effects, gastrointestinal symptoms, effects on the nervous system, hematopoietic and circulatory injury, and has reviewed the controversial question of liver and kidney damage. He reported on ten years' experience in an arsenal where several thousand people worked with tetryl at one time; the atmospheric concentration was held at 1.5 mg/M3 or below. No case of systemic poisoning was encountered. Some symptoms were noted, but the most troublesome reaction was skin sensitization.

"Based on these reports, a threshold limit value of 1.5 mg/M3 is recommended; it appears to be sufficiently low to prevent systemic poisoning, but not sensitization."

VAPOR PRESSURE AT 20 C: Much less than 1 mm Hg

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USE/EXPOSURE AND CONTROL DOCUMENT
TETRYL

Principal Route
of Entry

Currently Used
Control Methods

- | | Use/Exposure | Principal Route of Entry | Currently Used Control Methods |
|----|---|--------------------------|--|
| 1. | Inhalation of dust and skin contact with dust, crystals or pellets during use in the manufacture of explosives (blasting caps, booster explosive in high explosive shell, bursting charge in certain aircraft cannon shell and anti-aircraft shell, primer for less sensitive explosives). The exposure to tetryl occurs during the non-automated mixing, weighing, deducting, loading and assembling of explosive devices. | A,B,D | Process enclosure (when-ever possible); local exhaust ventilation; personal protective equipment (coveralls, aprons, gloves - fastened at wrist, sleeves - fastening over gloves at wrist, respiratory protective devices) |
| 2. | Inhalation of dust and skin contact with dust, crystals or pellets during formulation of binary explosives. Tetryl is sometimes used in this manner (Tetrytol - 70:30, Tetryl:TNT) | A,B,D | Process enclosure (when-ever possible); local exhaust ventilation; personal protective equipment (coveralls, aprons, gloves - fastened at wrist, sleeves - fastening over gloves at wrist, respiratory protective devices) |
| 3. | Inhalation of dust and skin contact with dust, crystals or pellets during the synthesis and processing of tetryl (nitration and partial oxidation of dimethyl-aniline). Tetryl is used as a powder or combined with graphite or stearic acid and pressed into pellets. | A,B,D | Process enclosure (when-ever possible); local exhaust ventilation; personal protective equipment (coveralls, aprons, gloves - fastened at wrist, sleeves - fastening over gloves at wrist, respiratory protective devices) |
| 4. | Inhalation of dust and skin contact with dust, powder or liquid during use as a pH indicator (pH 10.8 - colorless, pH 13.0 - reddish brown). | A,B,D | Local exhaust ventilation; personal protective equipment (gloves, coveralls) |

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The exposure to tetryl comes
mainly during the mixing
of the powder with the
solvent to make the
indicator solution.

- A -- Inhalation
- B -- Skin and eye contact resulting
in localized irritation
- C -- Ingestion
- D -- Skin contact resulting in
absorption and subsequent
systemic poisoning

----- JES2 JOB STATISTICS -----

1,304 CARDS READ

0 SYSOUT PRINT RECORDS

0 SYSOUT PUNCH RECORDS

0.00 MINUTES EXECUTION TIME

