NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND

SUPPORTING DOCUMENTATION FOR

*** TETRANITROMETHANE ***

NIOSH/OSHA Draft Technical Standard and Supporting Documentation for TETRANITROMETHANE

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 TETRANITROMETHANE.

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.

(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of tetranitromethane not in excess of 1 part per million (ppm) (8 milligrams 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 tetranitromethane.

(b) Exposure determination and measurement. (1) Each employer who has a place of employment in which tetranitromethane is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of tetranitromethane 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 tetranitromethane.

(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 tetranitromethane;

(ii) Any measurements of tetranitromethane taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to tetranitromethane; 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 tetranitromethane 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 tetranitromethane 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 tetranitromethane 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 tetranitromethane 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 tetranitromethane 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 tetranitromethane 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 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	± 25%
At or below permissible exposure and above the action level	± 35%
At or below the action level	± 50%

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

(2) Employee exposures to airborne concentrations of tetranitromethane 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 tetranitromethane.

(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 tetranitromethane 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 the respirator provided.

TABLE 2 RESPIRATORY PROTECTION FOR TETRANITROMETHANE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Vapor Concentration	
5 ppm or less	Any chemical cartridge respirator with full facepiece with cartridge providing protection against tetranitromethane.*
	A gas mask with chin style or front- or back-mounted canister providing protection against tetranitromethane.*
	Any supplied-air respirator with a full facepiece, helmet or hood.
	Any self-contained breathing apparatus with a full facepiece.
Greater than 5 ppm 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 escape self-conatined breathing apparatus.
	A gas mask providing protection against tetranitromethane.*

*Tetranitromethane is a strong oxidizer and should be kept away from

combustible materials. Some cartridges and canisters contain activated charcoal and shall not be used for protection against tetranitromethane. Only non-combustible sorbents are allowed.

(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 tetranitromethane.

(2) Tetranitromethane shall be stored so as not to come in contact with hydrocarbons, alkalies and metals.

(3) Sources of ignition such as smoking or open flames are prohibited where tetranitromethane presents a fire or explosion hazard.

(f) Personal protective equipment. (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent skin contact with solid or liquid tetranitromethane, where skin contact may occur. 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 tetranitromethane change into uncontaminated clothing before leaving the work premises. cleaned to remove the tetranitromethane, the employer shall inform the

(3) Employers shall ensure that non-impervious clothing which becomes contaminated with tetranitromethane be removed promptly and that any clothing which becomes wet with liquid tetranitromethane be removed immediately. Such clothing shall not be reworn until the tetranitromethane is removed from the clothing.

(4) Employers shall provide and ensure that employees use safety goggles (cup-cover type dust and splash safety goggles) which comply with § 1910.133 (a)(2)-(a)(6) where there is any possibility of solid or liquid tetranitromethane contacting the eyes.

(5) Where there is any possibility that an employee's eyes may be exposed to solid or liquid tetranitromethane, employers shall provide an eye-wash fountain within the immediate work area for emergency use.

(g) Spills and disposal. In the event that tetranitromethane 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 employees whose skin becomes contaminated with tetranitromethane promptly wash or shower with soap or mild detergent and water to remove any tetranitromethane from the skin.

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

(3) Employers shall ensure that employees who handle solid or liquid tetranitromethane 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 tetranitromethane 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 exposed to tetranitromethane above the action level without regard to the use of respirators, or employees who may have skin contact, or who may have any possibility of eye contact with solid or liquid tetranitromethane, or employees who work where tetranitromethane presents a fire or explosion hazard, shall annually:

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

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

(iii) Instruct affected employees to advise the employer of the development of signs and symptoms of overexposure to tetranitromethane 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 tetranitromethane.

(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 liquid tetranitromethane or airborne concentrations of tetranitromethane 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, blood, central nervous system, liver and skin;

(ii) 14" x 17" chest roentgenogram;

(iii) Forced vital capacity (FVC) and forced expiratory volume-one second (FEV (1 second)) tests;

(iv) 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 liquid tetranitromethane or airborne concentrations of tetranitromethane 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, blood, central nervous system, liver and skin;

(ii) Forced vital capacity (FVC) and forced expiratory volume-one second (FEV (1 second)) tests;

(iii) A 14" x 17" chest roentgenogram, if pulmonary function tests show significant abnormalities or when other signs or symptoms of respiratory disease occur;

(iv) 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:

(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 including methemoglobin determination for the employee if the employee informs the employer of any of the signs or symptoms of exposure to tetranitromethane which are listed in Appendix A or if overexposure to tetranitromethane is suspected.

(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 tetranitromethane:

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

(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 tetranitromethane;

(B) Any recommended limitations upon the employee's exposure to tetranitromethane, 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 pulmonary function tests and blood count;

(ii) The 14" x 17" chest roentgenogram when required, or a medically acceptable copy;

(iii) 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 tetranitromethane in such a way as would put the employee at increased risk of material impairment of his health from 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 tetranitromethane.

(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 tetranitromethane.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to tetranitromethane 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;

(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 tetranitromethane;

(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 tetranitromethane.

(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.

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

(2) When observation of measurement of employee exposure to tetranitromethane 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 tetranitromethane that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE: The information contained in the following appendix for tetranitromethane 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 tetranitromethane, it is advisory in nature.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET FOR TETRANITROMETHANE

I. SUBSTANCE IDENTIFICATION

A. Substance: Tetranitromethane

B. Permissible Exposure: 1 part of tetranitromethane per million parts of air (ppm) (8 milligrams of tetranitromethane per cubic meter of air (mg/M3)) averaged over an eight-hour work shift.

C. Appearance and Odor: Colorless to pale yellow liquid or solid. The vapor has a pungent odor and causes tears.

II. HEALTH HAZARD DATA

A. Ways in which the chemical affects your body: Tetranitromethane can affect your body if you inhale it or if it comes in contact with your eyes or skin. It may also affect your body if you swallow it.

B. Effects of Overexposure:

1. Exposure to tetranitromethane may cause irritation of the eyes, upper respiratory tract and skin. It may also cause headaches, fatigue and drowsiness. After prolonged exposure the central nervous system and heart may be affected and difficult breathing may occur. Tetranitromethane has been reported to affect the ability of the blood to carry oxygen. This may result in a bluish discoloration of the skin, headache, weakness, irritability, drowsiness, shortness of breath and unconsciousness.

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 tetranitromethane.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If solid or liquid tetranitromethane or strong concentrations of tetranitromethane vapors 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 promptly. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If solid or liquid tetranitromethane gets on your skin, promptly wash the contaminated skin using soap or mild detergent and water. If solid or liquid

tetranitromethane pentrates through your clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation is present after washing, get medical attention immediately.

C. Breathing: If you or any other person breathes in large amounts of tetranitromethane 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 solid or liquid tetranitromethane 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.

E. Rescue: Move 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 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 tetranitromethane. 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 can smell tetranitromethane while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. 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 skin contact with solid or liquid tetranitromethane where skin contact may occur. Replace or repair impervious clothing that has developed leaks.

C. Eye Protection: You must wear splash-proof safety goggles where there is any possibility of liquid tetranitromethane contacting your eyes. You must wear dust-resistant safety goggles where there is any possibility of solid tetranitromethane contacting your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

A. Tetranitromethane must be stored in tightly closed containers in a cool, well ventilated area away from hydrocarbons, alkalies, and metals.

B. Sources of ignition such as smoking and open flames are prohibited where tetranitromethane is handled, used, or stored in a manner that could create a potential fire or explosion.

C. If your work clothing may have become contaminated with solid tetranitromethane, you must change into uncontaminated clothing before leaving the work premises.

D. You must promptly remove any non-impervious clothing that becomes contaminated with tetranitromethane and you must immediately remove any clothing that becomes wet with liquid tetranitromethane. This clothing must not be reworn until the tetranitromethane is removed from the clothing.

E. If your skin becomes contaminated with tetranitromethane, you must promptly wash or shower with soap or mild detergent and water to remove the tetranitromethane from your skin.

F. You must not eat or smoke in areas where solid tetranitromethane is handled, processed or stored.

G. If you handle solid or liquid tetranitromethane, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.

H. Fire extinguishers and eye flushing facilities, where provided, must be readily available and you should know where they are and how to operate them.

I. Ask your supervisor where tetranitromethane 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 tetranitromethane. In addition, your employer must instruct you in the safe use of tetranitromethane, emergency procedures, and the correct use of protective equipment.

B. Your employer is required to determine whether you are being exposed to tetranitromethane. 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.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for TETRANITROMETHANE

NOTE: The information contained in the following appendix for tetranitromethane 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 tetranitromethane, it is advisory in nature.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
FOR TETRANITROMETHANE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Tetan
2. Formula: $C(NO_2)_4$
3. Molecular weight: 196

B. Physical Data

1. Boiling point (760 mm Hg): 126 C (259 F)
2. Specific gravity (water = 1): 1.64
3. Vapor density (air = 1 at boiling point of tetranitromethane): 6.8
4. Melting point: 14 C (57 F)
5. Vapor pressure at 20 C (68 F): 8.4 mm Hg
6. Solubility in water, by weight at 20 C (68 F): Insoluble
7. Evaporation rate (butyl acetate = 1): Data not available
8. Appearance and odor: Colorless to pale yellow liquid or solid. The vapor has a pungent odor and causes tears.

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Not combustible by itself but is considered by some to be a

B. Reactivity

1. Conditions contributing to instability: Combustible organic matter wet with tetranitromethane may be highly explosive and susceptable to initiation by rather mild shocks.
2. Incompatibilites: Contact with hydrocarbons, alkalies and metals may form explosive mixtures.
3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen and carbon monoxide) may be released in a fire involving tetranitromethane or when tetranitromethane decomposes.
4. Special precautions: Tetranitromethane will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If tetranitromethane is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.

3. Collect for reclamation or absorb in vermiculite, dry sand, earth or a similar material. Avoid shock and friction if liquid spills on combustible matter such as wood and paper.

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

C. Waste disposal methods: Liquid tetranitromethane may be disposed of by absorbing in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill. Solid tetranitromethane may be collected in the most convenient manner and disposed of in a secured sanitary landfill. Care must be taken when disposing, since tetranitromethane is a weak explosive.

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 gas and vapor adsorption tubes with subsequent chemical analysis. The method of measurement must determine the concentration of tetranitromethane 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 tetranitromethane 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 tetranitromethane in tightly closed containers in a cool, well ventilated area.

B. Employers should advise employees of all areas and operations where their exposure to tetranitromethane could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to tetranitromethane may occur are: During its production; formation as a volatile impurity; during the handling of crude trinitrotoluene; during its use as an oxidizer in some rocket fuels; during its production; during its use as an additive in diesel fuel (obsolete); and during its use in explosives manufacture and in laboratory use.

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 tetranitromethane, it is advisory in nature.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

Tetranitromethane vapor is a severe irritant of the eyes and respiratory tract. The LC50 for rats was 1230 ppm for 36 minutes; effects were lacrimation, rhinorrhea, gasping, and cyanosis; pulmonary edema was present at autopsy. Repeated exposure to 3.65 ppm for 6 months caused the death of 60% of the rats; at autopsy there were signs of lung infection following acute pneumonitis. In 3 species of animals, intravenous injection caused methemoglobinemia, anemia, damage to the central nervous system, and edema of the lungs and liver. In workers, various studies showed that exposure caused irritation of the eyes, nose, and throat; dizziness, headache; chest pain, dyspnea; and occasionally skin irritation. Methemoglobinemia is stated to be a systemic effect from human exposure; symptoms result from anoxia and include cyanosis evident especially in the lips, nose, and earlobes; other effects are weakness, dizziness, and severe headache. Concentrations in excess of 1 ppm will cause lacrimation and upper respiratory irritation while 0.4 ppm may cause mild irritation. The liquid on the skin may cause mild burns.

III. SIGNS AND SYMPTOMS

Irritation of eyes, nose, throat; dizziness, headache; chest pain, dyspnea; signs of methemoglobinemia including cyanosis of the lips, nose, and earlobes; skin burns; by analogy to effects caused in animals, it may

cause pulmonary edema, anemia, and damage to the central nervous system and liver.

IV. SPECIAL TESTS

Determination of methemoglobin concentration in the blood when tetranitromethane intoxication is suspected, and at regular intervals until the methemoglobin has been fully reduced to normal hemoglobin.

V. TREATMENT

Remove from exposure. Immediately flush eyes with water and wash the skin with soap or mild detergent and water. If swallowed and the person is conscious, immediately administer water orally and induce vomiting. Give artificial resuscitation and administer oxygen if indicated. Consideration should be given to hospitalization and observation for the possible delayed onset of pulmonary edema and treatment with corticosteroids if pulmonary edema occurs. Determine methemoglobin in blood and repeat every 3 to 6 hours for 18 to 24 hours. Consideration may be given to the intravenous administration of methylene blue at high levels of methemoglobin in an attempt to accelerate the conversion of methemoglobin to hemoglobin; however, the use of this agent is controversial due to its toxic effects.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of tetranitromethane are caused by its irritant properties, which may result in pulmonary edema and/or pneumonitis. Methemoglobinemia may occur. It is important that the physician become familiar with plant operating conditions in which exposure to tetranitromethane 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 tetranitromethane:

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. Examination of the respiratory tract, eyes, blood, central nervous system, and liver should be stressed. The skin should be examined for evidence of chronic disorders.

2. 14" x 17" chest roentgenogram -- Tetranitromethane causes human lung damage. Surveillance of the lungs is indicated.

3. FVC and FEV (1 sec) -- Tetranitromethane is a respiratory irritant. Persons with impaired pulmonary function may be at increased risk from exposure. Periodic surveillance is indicated.

4. A complete blood count -- Tetranitromethane has been shown to cause methemoglobinemia in humans. Persons with blood disorders may be at increased risk from exposure. 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

The above medical examinations are to be repeated on an annual basis except that an x-ray is required only when indicated by pulmonary function testing or when other signs or symptoms of respiratory disease occur. Methemoglobin determinations shall be performed if overexposure is suspected or signs and symptoms of toxicity occur.

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Tetranitromethane," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, pp. 254-255.

2. Hygienic Guide Series: "Tetranitromethane," American Industrial Hygiene Association Journal, 25:513-515, 1964.

3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 2075-2076.

4. Horn, H.J.: "Inhalation Toxicology of Tetranitromethane," A.M.A. Archives of Industrial Hygiene and Occupational Medicine, 10:213-222, 1954.

5. Hager, K.F.: "Tetranitromethane," Industrial and Engineering Chemistry, 41:2168-2172, 1949.

6. Mangelsdorff, A.F.: "Treatment of Methemoglobinemia," A.M.A. Archives of Industrial Hygiene and Occupational Medicine, 14:148-153, 1956.

REFERENCES AND SOURCES
TETRANITROMETHANE
1910.1000

(f) Personal Protective Equipment, and, (h) Sanitation

Eye: Deichmann and Gerarde, "Toxicology of Drugs and Chemicals;" Grant, "Toxicology of the Eye;" AIHA Hygienic Guide Series

Skin: Deichmann and Gerarde, "Toxicology of Drugs and Chemicals;" Patty, "Industrial Hygiene and Toxicology;" Sax, "Dangerous Properties of Industrial Materials;" International Labour Office, "Encyclopedia of Occupational Health and Safety;" AIHA Hygienic Guide Series; Stecher, "The Merck Index"

Ingestion: Patty, "Industrial Hygiene and Toxicology;" Deichmann and Gerarde, "Toxicology of Drugs and Chemicals;" Sax, "Dangerous Properties of Industrial Materials;" AIHA Hygienic Guide Series

COMMENT

Eye - Classification: 1 and 5
Output statement numbers: 9 and 11 combined, 13
Exceptions: None

Deichmann and Gerarde and the Hygienic Guide report that "tetranitromethane is a corrosive chemical similar to nitrous acid. It causes conjunctival inflammation, ulceration, and in more severe contacts, pupillary changes and paralysis of the eye muscles, as well as severe burns."

Grant reports that vapors of this compound are "very irritating to the eyes" and for this reason it has been proposed as a war gas.

Little information is available concerning the effects of eye contact with this substance. Most sources simply state the vapors are highly irritating. The AIHA and Deichmann and Gerarde, however, flatly state that the substance (presumably in liquid form) is corrosive and causes severe eye injury. Given the importance of preventing permanent eye damage from accidental contacts, the substance is, therefore, assigned classifications of 1 and 5.

Skin - Classifications: 2 and 6
Output statement numbers: 2, 5b, 17g and 21 combined, 17i and 20a
Exceptions: See below

According to the Hygienic Guide and Deichmann and Gerarde, "tetranitromethane is a corrosive chemical similar to nitrous acid. Skin absorption is unlikely because of its reactivity with skin surfaces as indicated by the formation of pigmented areas."

Patty notes that "skin irritation does not result from repeated contact in man or animals," and further adds in general that the nitroparaffins when applied to the skin, "give no evidence of sufficient absorption to produce systemic injury."

Sax, however, lists the acute and chronic systemic effects by skin absorption as being of high toxic hazard.

The ILO says that the polynitroparaffins are considerably more toxic than the mononitroparaffins, "may be either solids

or liquids at normal temperatures," and may cause skin irritation.

The Merck Index states "Caution: Skin and Lung Irritant. Highly explosive in the presence of impurities."

Tetranitromethane has a melting point of 57 degrees F and a vapor pressure of 8.4 mm Hg at 20 degrees C. It is insoluble in water and is not combustible but can explode in contact with hydrocarbons and other combustible substances.

The data are somewhat contradictory concerning the effects of skin contact. Since the most severe local effect noted is one of the "formation of pigmented areas," and since there is no indication that skin absorption takes place readily, classifications of 2 and 6 are concluded to be adequate if statement 2 is used to prevent contact where it "may occur." Statement 21 is used because of the explosivity of the substance and for the same reason, statement 7a is not spe

Ingestion - Classification: 2 and 6

Output statement numbers: 19, 20a

Exceptions: None

According to Patty, "the nitroparaffins are absorbed . . . from the gastrointestinal tract. Symptoms (of inhalation) progress to cyanosis, excitement and death at higher concentrations. The results of pathological examinations on animals dying from acute exposures were all similar. Non-specific changes in the liver and kidney were observed in some animals."

Deichmann and Gerarde have reported heart and nervous system disorders after prolonged exposure to vapors.

Sax states of the inhalation effects that this compound "can cause pulmonary edema, mild methemoglobinemia, and fatty degeneration of the liver and kidneys." He lists its acute and chronic systemic effects of ingestion as being of high toxic hazard.

The Hygienic Guide Series says that "accidental ingestion of the material is unlikely except through lack of assiduous cleanliness; however, ingestion toxicity is considered to be extremely high."

The specific effects of ingestion would not appear to have been studied. Based upon preceding comments, however, it can be concluded that classifications of 2 and 6 are sufficient.

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," 1st edition, vol. 9, p. 430; Vol. 6, p. 224

Merck Index," 8th edition, 1968 (Merck)

American Industrial Hygiene Association, Hygienic Guide Series (Hyg)

Sax, N.I. - Dangerous Properties of Industrial Materials (Sax)

Sources of data items used:

1. A. 1. Synonyms: K-O

2. Formula: K-O
3. Molecular weight: K-O

B. 1. Boiling point: K-O
2. Specific gravity: K-O
3. Vapor density: ADL
4. Melting point: K-O
5. Vapor pressure: Hyg
6. Solubility in water: K-O
7. Evaporation rate: Data not available
8. Appearance and odor: K-O

II. A. 1. Sax, NFPA-491M, DOT

B. 1. Conditions contributing to instability: K-O, Sax, NFPA-491M
2. Incompatibilities: NFPA-491M, K-O
3. Hazardous decomposition products: ADL
4. Special precautions: Merck

III. A. Steps if released or spilled: ADL

C. Waste disposal method: ADL

V. Miscellaneous precautions: ADL

VI. Common operations: K-O, Merck

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

Forsten, I., "Pollution Abatement in a Munitions Plant," Environ. Sci. Tech., 7(9), p. 806 - 10, 1973 (NIOSH Technical Information Service NIOSH 21221)

Hager, K. F., "Tetranitromethane," Ind. Eng. Chem., 14(10), p. 2168 - 72, 1949 (Hager)

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

Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience Publishers, 1st edition, 1954 (Chem Tech)

McKetta, J. J., Jr. - editor, "Advances in Petroleum Chemistry and Refining," Vol. 10, Interscience, 1965 (McKetta)

von Oettingen, W. F., "Poisoning," Saunders, 2nd edition, 1958 (von Oettingen)

Patty, F. A., "Industrial Hygiene and Toxicology," Vol. II, Interscience, 1962 (Patty)

"Tetranitromethane," American Conference of Governmental Industrial Hygienists, Hygienic Guide Series, October, 1964 (Guide)

References for Specific Use/Exposure

1. Guide, Hager, Patty, Chem Tech, NIOSH 21221
2. McKetta, Hager
3. ILO, Patty, Hager
4. Guide, Hager
5. McKetta, Patty, Guide

References for Specific Control Methods

Guide, ILO and von Oettingen were the references used in all the Specific Control Methods.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for TETRANITROMETHANE

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Tetranitromethane

D. O. L. STANDARD: 1 ppm

WARNING PROPERTIES:

Odor Threshold: Patty states that "tetranitromethane can be recognized by its characteristic acrid biting odor." No quantitative information is available, however, concerning the odor threshold of tetranitromethan

Irritation Level: The AIHA Hygienic Guides state that "the irritant property of tetranitromethane may serve as an index to the degree of exposure which can be tolerated because concentrations in excess of one ppm will cause lacrimation and upper respiratory irritation. Concentrations as low as 0.4 ppm may cause mild irritation." Grant states that "the vapors of tetranitromethane are very irritating to the eyes, nose, and respiratory passages. It has been proposed for use as an irritant war gas. Animals are said to show evidence of irritation of the eyes rather quickly at concentrations from 3.3 to 25.2 ppm in air." For the purposes of this standard, only full facepiece respirators are permitted

Evaluation of Warning Properties: Through its irritant effects, tetranitromethane can be detected below the permissible exposure limit. For the purposes of this standard, therefore, tetranitromethane could be treated as a material with good warning properties, and gas sorbent respiratory equipment would be permitted. Since tetranitromethane is such a strong oxidizer, only non-combustible sorbents are permitted for in cartridges or canisters.

IDLH: 5 ppm

Basis for IDLH Value: This IDLH is based upon the report in the AIHA Hygieni Guides that "concentrations above 5 ppm may cause irreversible lung and systemic damage." According to the Hygienic Guides, the atmospheric concentration which is immediately hazardous to life is unknown for humans. Patty reports that a cat exposed to 10 ppm for 20 minutes died within 10 days, and 5 cats exposed to 7 - 25 ppm for periods ranging from 2 1/2 to 5 hours died within 1 to 5 hours.

Other Toxicological Information: The AIHA Hygienic Guides state that "the inhalation of tetranitromethane causes severe irritation to the lungs and mucous membranes. Animal exposures resulted in pulmonary edema with ET50's (estimated time at which 50% of the animals will not survive) of 36.3 minutes at 1230 ppm, 1.0 hour at 300 ppm 5.8 hours at 33 ppm, 6 hours per day for 133 days at 6.35 ppm. Human exposure data are limited to the simultaneous exposure to TNT and to the impurity (sic) tetranitromethane in munitions manufacture. Various studies showed that light cases of poisoning caused dizziness, dyspnea, pain and oppression in the chest, associated with scratchy throat, cough, burning eyes and occasionally skin irritation. Prolonged exposure affects the heart and the central nervous system." Concerning the atmospheric concentrations immediately hazardous to life, the Hygienic Guides state that "animal data indicate that concentrations above 5 ppm may cause irreversible lung and systemic damage."

Patty reports that "a summary of the data on the response of animals to inhalation of various concentrations of tetranitromethane appears in the table below. In all reported experiments, exposed animals have exhibited similar symptoms, chiefly those of respiratory

RESPONSE TO VARIOUS CONCENTRATIONS OF
TETRANITROMETHANE

Animals	Concentration ppm	Duration of exposure	Response
1 cat	100	20 mins.	Death in 1 hour
1 cat	10	20 mins.	Death in 10 days
5 cats	7 - 25	2 1/2 - 5 hrs.	Death in 1 - 5 1/2 hr.
2 cats	3 - 9	6 hrs. x 3	Severe irritation
2 cats	0.1 - 0.4	6 hrs. x 2	Mild irritation
20 rats	1230	1 hour	All died in 25 - 50 mins.
20 rats	300	1 1/2 hours	All died in 40 - 90 mins.
20 rats	33	10 hrs.	All died in 3 - 10 hours
19 rats	6.35	6 mons.	11 deaths
2 dogs	6.35	6 mons.	Mild symptoms

tract irritation. The first signs are increased preening, change in the respiratory pattern, and evidences of eye irritation followed by rhinorrhea, gasping and salivation. The symptoms progress to cyanosis, excitement, and death at higher concentrations. Methemoglobinemia occured in exposed cats. It should be noted that Sievers et al. exposed their animals to tetranitromethane from crude trinitrotoluene and although the concentrations recorded for tetranitromethane were determin by sampling and analysis, other unknown contaminants could have been present. These investigators found that animals exposed to 3 to 9 ppm for 1 to 3 days developed pulmonary edema. Lower concentrations (0.1 to 0.4 ppm) produced only mild irritation. Horn exposed 2 dogs and 19 rats to 6.35 ppm for 6 hours a day, 5 days a week, for 6 months. Eleven of the 19 rats died in the course of the experiment with evidence of pulmonary irritation, edema, and pneumonia. Some initial anorexia was observed in the dogs. Repeated examinations did not reveal anemia, Heinz bodies, methemoglobinemia, or biochemical disturbances."

The Documentation of TLV's states that "the TLV of 1 ppm is recommended to prevent irritation of respiratory passages and other toxic effects. This may not be low enough to prevent all irritation.

"Other recommendations: Smyth (1956) believed 1 ppm was too high; Elkins (1959) 0.5 ppm; U.S.S.R. (1967) 0.04 ppm."

LFL: Tetranitromethane is not combustible.

VAPOR PRESSURE AT 20 C: 8.4 mm Hg

SATURATED CONCENTRATION AT 20 C: Approximately 11,100 ppm

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for TETRANITROMETHANE

USE/EXPOSURE AND CONTROL DOCUMENT
TETRANITROMETHANE

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor and skin contact with liquid during use in explosives manufacture (ingredient with toluene, nitrobenzene, or nitrotoluene for liquid explosives; contaminant of crude TNT)	A,B	Process enclosure; local exhaust ventilation; persona protective equipment (respiratory protective devices, gloves, body protection, eye protection); good personal hygiene practice
2.	Inhalation of vapor and skin contact with liquid during manufacture and distribution and during maintenance of equipment and storage containers	A,B	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, body protection, eye protection); good personal hygiene practice
3.	Inhalation of vapor and skin contact with liquid during use in diesel fuels (improves cetane number)	A,B	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, body protection, eye protection); good personal hygiene practice
4.	Inhalation of vapor and skin contact with liquid during laboratory use (as analytical reagent for double bonds; as mild nitrating agent)	A,B	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, body protection, eye protection); good personal hygiene practice
5.	Inhalation of vapor and skin contact with liquid during use (research) in rocket propellants	A,B	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, body protection, eye protection); good personal hygiene practice

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