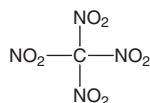


## Tetranitromethane

### CAS No. 509-14-8

Reasonably anticipated to be a human carcinogen  
First Listed in the *Seventh Annual Report on Carcinogens* (1994)



### Carcinogenicity

Tetranitromethane is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals. Exposure to tetranitromethane in a two-year inhalation bioassay caused a dose-related increase in alveolar/bronchiolar neoplasms to nearly all mice and rats exposed to concentrations of 2 and 5 ppm respectively. The incidences of these neoplasms in lower exposure concentration groups (2 ppm for rats and 0.5 ppm for mice) were 66% and 44% in male and female rats, respectively, and 54% and 48% in male and female mice, respectively (NTP 1990). The majority of animals with alveolar/bronchiolar neoplasms had neoplasms diagnosed as carcinomas, and these neoplasms frequently metastasized to a variety of organs. Squamous cell carcinomas of the lung were also markedly increased in rats exposed to 5 ppm. This particular type of neoplasm has been found in only 3 of approximately 1,600 untreated control male rats and in none of a similar number of untreated female controls (NTP 1990).

No adequate human studies of the relationship between exposure to tetranitromethane and human cancer have been reported (IARC 1996).

### Properties

Tetranitromethane is a colorless to pale yellow, oily liquid with a pungent odor. It is soluble in alcohol and ether, but it is insoluble in water. It is sensitive to heat, friction, and shock. It is prepared by nitration of acetic anhydride with anhydrous nitric acid (Merck 1989). It is an oxidizer and is highly explosive in the presence of impurities. In addition, tetranitromethane is the principal volatile contaminant of TNT and may constitute as much as 0.12% of the crude material (NTP 1990).

### Use

Tetranitromethane is used as an oxidizer in rocket propellants and explosives, and as an additive to increase the cetane number of diesel fuel (NTP 1990, IARC 1996, HSDB 2000). It is also used as a reagent for detecting the presence of double bonds in organic compounds, and as a mild nitrating reagent, reacting with tyrosine residues in proteins.

### Production

No current estimates of the amount of tetranitromethane commercially produced were found in the literature. Chem Sources (2001) lists six current suppliers of tetranitromethane in the United States. In Germany during World War II, attempts were made to synthesize large amounts for use as a substitute for nitric acid in rocket fuel. This method, involving the nitration of acetic anhydride with nitric acid, allowed a production rate of up to 10 tons within a few weeks, but the process was costly. By the end of the war, a less-costly method was devised using acetylene and nitric acid, with a reported capacity of 10 kg/day (NTP 1990).

### Exposure

The primary route of potential human exposure to tetranitromethane is inhalation. Historically, human exposure to tetranitromethane presumably occurred during the manufacture and use of TNT (NTP 1990). Tetranitromethane may be released into the environment during its manufacture and use as a rocket fuel, diesel fuel booster, organic reagent, or as an explosive in mixture with toluene (HSDB 2000). During the early part of World War I, there was a high incidence of "TNT intoxication" in U.S. and British facilities involved in TNT production; an additional step involving washing the crude material with a sodium sulfite solution to hydrolyze the tetranitromethane was introduced to alleviate this problem. Tetranitromethane has been reported to be an atmospheric pollutant emitted as a by-product of explosives produced in factories owned by the U.S. Government. The estimated "worst-case" pollutant level of tetranitrotoluene in the vicinity of the factories was 20 mg/m<sup>3</sup> (approximately 2.5 ppm). The National Occupational Exposure Survey, conducted by NIOSH from 1981 to 1983, indicated that 1,445 workers, including 230 women, were potentially exposed to tetranitromethane. This estimate was based on observations of the actual use of the compound (NIOSH 1984).

### Regulations

#### DOT

Tetranitromethane is considered a hazardous material and special requirements have been set for marking, labeling, and transporting this material

#### EPA

##### Clean Air Act

Prevention of Accidental Release: Threshold Quantity (TQ) = 10,000 lb  
Comprehensive Environmental Response, Compensation, and Liability Act

Reportable Quantity (RQ) = 10 lb

##### Emergency Planning and Community Right-To-Know Act

Reportable Quantity (RQ) = 10 lb

Threshold Planning Quantity (TPQ) = 500 lb

##### Resource Conservation and Recovery Act

Listed Hazardous Waste: Waste codes in which listing is based wholly or partly on substance - P112

Listed as a Hazardous Constituent of Waste

#### OSHA

Permissible Exposure Limit (PEL) = 1 ppm (8 mg/m<sup>3</sup>)

### Guidelines

#### ACGIH

Threshold Limit Value - Time-Weighted Average Limit (TLV-TWA) = 0.005 ppm

#### NIOSH

Recommended Exposure Limit (REL) = 1 ppm (8 mg/m<sup>3</sup>)

Immediately Dangerous to Life and Health (IDLH) = 4 ppm

### REFERENCES

- ChemSources. 2001. Chemical Sources International, Inc. <http://www.chemsources.com>.  
 HSDB. 2000. Hazardous Substances Data Base. National Library of Medicine. <http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB>.  
 IARC. 1996. Printing Processes and Printing Inks, Carbon Black and Some Nitro Compounds. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans, vol. 65. Lyon, France: International Agency for Research on Cancer. 578 pp.  
 Merck. 1989. The Merck Index, 11th ed. Rahway, NJ: Merck & Company, Inc.  
 NIOSH. 1984. National Occupational Exposure Survey (1981-83). Cincinnati, OH: U. S. Department of Health and Human Services. <http://www.cdc.gov/noes/noes3/empl0003.html>.  
 NTP. 1990. Toxicology and Carcinogenesis Studies of Tetranitromethane (CAS No. 509-14-8) in F344/N Rats and B6C3F1 Mice (Inhalation Studies). Technical Report Series No 386. NIH Publication No. 90-2841. Research Triangle Park, NC and Bethesda, NC: National Toxicology Program. 207 pp.