

# OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR 2-NITROPROPANE POTENTIAL HUMAN CARCINOGEN

## INTRODUCTION

This guideline summarizes pertinent information about 2-nitropropane for workers, employers, and occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; therefore, readers are advised to regard these recommendations as general guidelines.

## SUBSTANCE IDENTIFICATION

• **Formula:** C<sub>3</sub>H<sub>7</sub>NO<sub>2</sub>

• **Structure:**

$$\begin{array}{c} \text{NO}_2 \\ | \\ \text{CH}_3-\text{CH}-\text{CH}_3 \end{array}$$

• **Synonyms:** Dimethylnitromethane; isonitropropane; 2-NP

• **Identifiers:** CAS 79-46-9; RTECS TZ5250000; DOT 2608, label required: "Flammable Liquid"

• **Appearance and odor:** Clear, colorless liquid with a fruity odor

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 89.09
2. Boiling point (at 760 mmHg): 118°-120°C (244°-248°F)
3. Specific gravity (water = 1): 0.992
4. Vapor density (air = 1 at boiling point of 2-nitropropane): 3.07
5. Melting point: -93°C (-135°F)
6. Vapor pressure at 25°C (77°F): 20 mmHg
7. Solubility in water, g/100 g water at 25°C (77°F): 1.7
8. Evaporation rate (butyl acetate = 1): 1.62
9. Saturation concentration in air (approximate) at 25°C (77°F): 2.6% (26,000 ppm)
10. Ionization potential: 10.71eV

### • Reactivity

1. Incompatibilities: Contact with amines, strong acids, alkalis, or strong oxidizers may cause fire and explosion. Con-

tact with some metal oxides may cause decomposition. Mixtures of 2-nitropropane and hydrocarbons are highly flammable.

2. Hazardous decomposition products: Toxic vapors and gases (e.g., carbon monoxide and oxides of nitrogen) may be released in a fire involving 2-nitropropane.

3. Caution: Overheating 2-nitropropane in closed container may cause violent explosion. 2-Nitropropane will attack some forms of plastics, coatings, and rubber.

### • Flammability

1. Flash point: 24°C (75°F) (closed cup)
2. Autoignition temperature: 428°C (802°F)
3. Flammable limits in air, % by volume: Lower, 2.6; upper, 11.0
4. Extinguishant: Dry chemical, foam, or carbon dioxide
5. Class IC Flammable Liquid (29 CFR 1910.106), Flammability Rating 3

### • Warning properties

1. Odor threshold: 83 ppm
2. Eye irritation level: 150 ppm
3. Evaluation of warning properties for respirator selection: Warning properties are not considered in recommending respirators for use with carcinogens.

## EXPOSURE LIMITS

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for 2-nitropropane is 25 parts of 2-nitropropane per million parts of air (ppm) [90 milligrams of 2-nitropropane per cubic meter of air (mg/m<sup>3</sup>)] as a time-weighted average (TWA) concentration over an 8-hour workshift. The National Institute for Occupational Safety and Health (NIOSH) recommends that 2-nitropropane be controlled and handled as a potential human carcinogen in the workplace; thus, the recommended exposure limit (REL) is that exposure be minimized to the lowest feasible level. The American Conference of Governmental Industrial Hygienists (ACGIH) has designated 2-nitropropane as an A2 substance (suspected human carcinogen) having an assigned threshold limit value (TLV<sup>®</sup>) of 10 ppm (35 mg/m<sup>3</sup>) as TWA for a normal 8-hour workday and a 40-hour workweek (Table 1).

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service      Centers for Disease Control  
National Institute for Occupational Safety and Health  
Division of Standards Development and Technology Transfer

**Table 1.—Occupational exposure limits for 2-nitropropane**

	Exposure limits	
	ppm	mg/m <sup>3</sup>
OSHA PEL TWA	25	90
NIOSH REL (Ca)*	Lowest feasible level	
ACGIH TLV® TWA (A2)†	10	35

\* (Ca): NIOSH recommends treating as a potential human carcinogen.

† (A2): Suspected human carcinogen.

## HEALTH HAZARD INFORMATION

### • Routes of exposure

2-Nitropropane may cause adverse health effects following exposure via inhalation, ingestion, or dermal or eye contact.

### • Summary of toxicology

1. *Effects on animals:* In rats, acute inhalation of 2-nitropropane caused progressive weakness, impaired muscular coordination (ataxia), and irregular breathing; in rats, rabbits, and guinea pigs, acute inhalation caused degeneration of the liver (necrosis), pulmonary edema and hemorrhage, selective destruction of brain cells, and vascular epithelial damage in all tissues. Subchronic inhalation of 2-nitropropane by rats produced an increased incidence of liver cancer. Intraperitoneal injection of 2-nitropropane in pregnant rats on days 1 through 15 of gestation caused retarded heart development in unborn fetuses.

2. *Effects on humans:* Acute inhalation exposure of workers to 2-nitropropane has produced toxic hepatitis, gastrointestinal bleeding, pulmonary edema, fatty degeneration and necrosis of the liver, and degeneration of kidney tubules; acute lethal exposure has also occurred. Chronic exposure of workers to 2-nitropropane has been associated with an increased incidence of lymphatic and connective tissue cancers.

### • Signs and symptoms of exposure

*Short-term (acute):* Exposure to 2-nitropropane can cause nausea, vomiting, diarrhea, anorexia, severe headaches, breathing difficulty (dyspnea), impaired muscular coordination, and chest and abdominal pains.

## RECOMMENDED MEDICAL PRACTICES

### • Medical surveillance program

Workers with potential exposures to chemical hazards should be monitored in a systematic program of medical surveillance intended to prevent or control occupational injury and disease. The program should include education of employers and workers about work-related hazards, placement of workers in jobs that do not jeopardize their safety and health, earliest possible detection of adverse health effects, and referral of workers for diagnostic confirmation and treatment. The occurrence of disease (a "sentinel health event," SHE) or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical surveillance program is intended to supplement, not replace, such measures.

A medical surveillance program should include systematic collection and epidemiologic analysis of relevant environmental and biologic monitoring, medical screening, morbidity, and mortality data. This analysis may provide information about the relatedness of adverse health effects and occupational exposure that cannot be discerned from results in individual workers. Sensitivity, specificity, and predictive values of biologic monitoring and medical screening tests should be evaluated on an industry-wide basis prior to application in any given worker group. Intrinsic to a surveillance program is the dissemination of summary data to those who need to know, including employers, occupational health professionals, potentially exposed workers, and regulatory and public health agencies.

### • Preplacement medical evaluation

Prior to placing a worker in a job with a potential for exposure to 2-nitropropane, the physician should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on the function and integrity of the eyes, skin, liver, kidneys, and nervous and respiratory systems. Medical surveillance for respiratory disease should be conducted by using the principles and methods recommended by NIOSH and the American Thoracic Society (ATS).

A preplacement medical evaluation is recommended in order to detect and assess preexisting or concurrent conditions which may be aggravated or result in increased risk when a worker is exposed to 2-nitropropane. The examining physician should consider the probable frequency, intensity, and duration of exposure, as well as the nature and degree of the condition, in placing such a worker. Such conditions, which should not be regarded as absolute contraindications to job placement, include a history of chronic disease of the respiratory tract or liver. In addition to the medical interview and physical examination, the means to identify respiratory conditions may include the methods recommended by NIOSH and ATS. The physician should obtain baseline values for tests of liver function.

### • Periodic medical screening and/or biologic monitoring

Occupational health interviews and physical examinations should be performed at regular intervals. Additional examinations may be necessary should a worker report symptoms that may be attributed to exposure to 2-nitropropane. The interviews, examinations, and appropriate medical screening and/or biologic monitoring tests should be directed at identifying an excessive decrease or adverse trend in the physiologic function of the liver, kidneys, and nervous and respiratory systems as compared to the baseline status of the individual worker or to expected values for a suitable reference population. The following tests should be used and interpreted according to standardized procedures and evaluation criteria recommended by NIOSH and the ATS: standardized questionnaires, tests of lung function, and chest X-rays.

- **Medical practices recommended at the time of job transfer or termination.**

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic and laboratory tests which were conducted at the time of placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared to those expected for a suitable reference population. Because occupational exposure to 2-nitropropane may cause diseases of prolonged induction-latency, the need for medical surveillance may extend well beyond termination of employment.

## MONITORING AND MEASUREMENT PROCEDURES

- **Method**

Sampling and analysis may be performed by collecting 2-nitropropane vapors with Chromosorb 106 tubes followed by desorption with ethyl acetate and analysis by gas chromatography. Direct-reading devices calibrated to measure 2-nitropropane may also be used if available. A detailed sampling and analytical method for 2-nitropropane may be found in the *NIOSH Manual of Analytical Methods* (method number 272).

## PERSONAL PROTECTIVE EQUIPMENT

Chemical protective clothing (CPC) should be selected after utilizing available performance data, consulting with the manufacturer, and then evaluating the clothing under actual use conditions.

Workers should be provided with and required to use CPC, gloves, and other appropriate protective clothing necessary to prevent skin contact with 2-nitropropane.

## SANITATION

Clothing which is contaminated with 2-nitropropane should be removed immediately and placed in sealed containers for storage until it can be discarded or until provision is made for the removal of 2-nitropropane from the clothing. If the clothing is to be laundered or cleaned, the person performing the operation should be informed of 2-nitropropane's hazardous properties. Reusable clothing and equipment should be checked for residual contamination before reuse or storage.

A change room with showers, washing facilities, and lockers that permit separation of street and work clothes should be provided.

Workers should be required to shower following a workshift and prior to putting on street clothes. Clean work clothes should be provided daily.

Skin that becomes contaminated with 2-nitropropane should be promptly washed with soap and water.

The storage, preparation, dispensing, or consumption of food or beverages, the storage or application of cosmetics, the storage or use of smoking materials, or the storage or use of products for chewing should be prohibited in work areas.

Workers who handle 2-nitropropane should wash their faces, hands, and forearms thoroughly with soap and water before eating, smoking, or using toilet facilities.

## COMMON OPERATIONS AND CONTROLS

Common operations in which exposure to 2-nitropropane may occur and control methods which may be effective in each case are listed in Table 2.

**Table 2.—Operations and methods of control for 2-nitropropane**

Operations	Controls
During the manufacture and distribution of 2-nitropropane; during maintenance of equipment and storage containers for 2-nitropropane	Process enclosure, local exhaust ventilation, personal protective equipment
During the manufacture of explosives; during use as a thinner and solvent	Process enclosure, local exhaust ventilation, personal protective equipment
During use in organic chemical synthesis; during use as a propellant in rocket motors	Local exhaust ventilation, personal protective equipment

## EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, remove the victim from further exposure, send for medical assistance, and initiate emergency procedures.

- **Eye exposure**

Where there is any possibility of a worker's eyes being exposed to 2-nitropropane, an eye-wash fountain should be provided within the immediate work area for emergency use.

If 2-nitropropane gets into the eyes, flush them immediately with large amounts of water for 15 minutes, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.

- **Skin exposure**

Where there is any possibility of a worker's body being exposed to 2-nitropropane, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

If 2-nitropropane gets on the skin, wash it immediately with soap and water. If 2-nitropropane penetrates the clothing, remove the clothing immediately and wash the skin with soap and water. Get medical attention promptly.

- **Rescue**

If a worker has been incapacitated, move the affected worker from the hazardous exposure. Put into effect the established

emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

## SPILLS AND LEAKS

Workers not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

If 2-nitropropane is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities of liquids containing 2-nitropropane, absorb on paper towels and place in an appropriate container.
4. Large quantities of liquids containing 2-nitropropane may be absorbed in vermiculite, dry sand, earth, or a similar material and placed in an appropriate container.
5. Liquids containing 2-nitropropane may be collected by vacuuming with an appropriate system. If a vacuum system is used, there should be no sources of ignition in the vicinity of the spill, and flashback prevention devices should be provided.

## WASTE REMOVAL AND DISPOSAL

U.S. Environmental Protection Agency, Department of Transportation, and/or state and local regulations shall be followed to assure that removal, transport, and disposal are in accordance with existing regulations.

## RESPIRATORY PROTECTION

It must be stressed that the use of respirators is the least preferred method of controlling worker exposure and should not normally be used as the only means of preventing or minimizing exposure during routine operations. However, there are some exceptions for which respirators may be used to control exposure: when engineering and work practice controls are not technically feasible, when engineering controls are in the process of being installed, or during emergencies and certain maintenance operations, including those requiring confined-space entry (Table 3).

In addition to respirator selection, a complete respiratory protection program should be instituted which as a minimum complies with the requirements found in the OSHA Safety and Health Standards, 29 CFR 1910.134. A respiratory protection program should include as a minimum an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, fit testing, periodic environmental monitoring, maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program, including selection of the correct respirators, requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly.

Only respirators that have been approved by the Mine Safety and Health Administration (MSHA, formerly Mining Enforcement and Safety Administration) and by NIOSH should be

used. **Remember! Air-purifying respirators will not protect from oxygen-deficient atmospheres.**

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**Table 3.—Respiratory protection for 2-nitropropane**

Condition	Minimum respiratory protection*
Any detectable concentration	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode  Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode
Planned or emergency entry into environments containing unknown or any detectable concentration	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode  Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode
Firefighting	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode
Escape only	Any appropriate escape-type self-contained breathing apparatus

\* Only NIOSH/MSHA-approved equipment should be used.