OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR
2-NITROPROPAINE
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 Recommendations may be superseded by new developments in these fields; therefore, readers are advised to regard these recommendations as general guidelines.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: C₃H₇NO₂
- Structure: \[ \text{NO}_2 \]
  \[ \text{CH}_3-\text{CH}-\text{CH}_3 \]
- 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: 10.7 eV
- Reactivity
  1. Incompatibilities: Contact with amines, strong acids, alkalis, or strong oxidizers may cause fire and explosion. Contact with some metal oxides may cause decomposition.

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/m³)) 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®) of 10 ppm (35 mg/m³) as TWA for a normal 8-hour workday and a 40-hour workweek (Table 1).
Table 1.—Occupational exposure limits for 2-nitropropane

<table>
<thead>
<tr>
<th>Exposure limits</th>
<th>ppm</th>
<th>mg/m³</th>
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<tbody>
<tr>
<td>OSHA PEL TWA</td>
<td>25</td>
<td>90</td>
</tr>
<tr>
<td>NIOSH REL (Ca)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACGIH TLV® TWA (A2)†</td>
<td>10</td>
<td>35</td>
</tr>
</tbody>
</table>

*(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.

- 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 72).

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

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

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.

**BIBLIOGRAPHY**

- American Conference of Governmental Industrial Hygienists: *Documentation of the Threshold Limit Values and Biological Exposure Indices* (5th ed.), Cincinnati, 1986.
- American Conference of Governmental Industrial Hygienists: *TLVs*® *Threshold Limit Values and Biological Exposure Indices for 1987-88*, Cincinnati, 1987.


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

<table>
<thead>
<tr>
<th>Condition</th>
<th>Minimum respiratory protection*</th>
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<tbody>
<tr>
<td>Any detectable concentration</td>
<td>Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode</td>
</tr>
<tr>
<td>Planned or emergency entry into environments containing unknown or any detectable concentration</td>
<td>Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode</td>
</tr>
<tr>
<td>Firefighting</td>
<td>Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode</td>
</tr>
<tr>
<td>Escape only</td>
<td>Any appropriate escape-type self-contained breathing apparatus</td>
</tr>
</tbody>
</table>

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