

OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR ETHYLIDENE NORBORNENE

INTRODUCTION

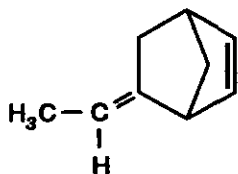
This guideline summarizes pertinent information about ethylidene norbornene for workers and employers as well as for physicians, industrial hygienists, and other occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether new information is available.

SUBSTANCE IDENTIFICATION

• Formula



• Structure



• Synonyms

5-Ethylidene-2-norbornene; 5-ethylidenebicyclo(2,2,1)hept-2-ene; ENB

• Identifiers

1. CAS No.: 16219-75-3
2. RTECS No.: RB9450000

3. DOT UN: None

4. DOT label: None

• Appearance and odor

Ethylidene norbornene is a combustible, colorless to white liquid with a turpentine-like odor. An odor threshold for ethylidene norbornene has been reported in the range of 0.007 to 0.014 parts per million (ppm) parts of air.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 120.2
2. Boiling point (760 mm Hg): 147.6°C (298°F)
3. Specific gravity (water = 1): 0.896 at 20°C (68°F)
4. Vapor density (air = 1 at boiling point of ethylidene norbornene): 4.1
5. Freezing/Melting point: -80°C (-112°F)
6. Vapor pressure at 20°C (68°F): 4.2 mm Hg
7. Solubility: Data not available
8. Evaporation rate: Data not available

• Reactivity

1. Conditions contributing to instability: Heat, sparks, open flame, and oxygen.

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Public Health Service
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Education and Information Division

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Occupational Safety and Health Administration

2. Incompatibilities: Contact of ethylidene norbornene with oxygen can cause violent reactions.
3. Hazardous decomposition products: Toxic gases (such as carbon dioxide) may be released in a fire involving ethylidene norbornene.
4. Special precautions: Because of its reactivity, ethylidene norbornene must be stabilized with tert-butyl catechol.

- **Flammability**

The National Fire Protection Association has not assigned a fire hazard rating for ethylidene norbornene; however, other sources report that this substance is combustible.

1. Flash point: 38.33°C (101°F) (open cup)
2. Autoignition temperature: Data not available
3. Flammable limits in air: Data not available
4. Extinguishant: Use dry chemical, alcohol foam, or carbon dioxide to fight fires involving ethylidene norbornene. Water may be ineffective, but it may be used to cool fire-exposed containers.

Fires involving ethylidene norbornene should be fought upwind from the maximum distance possible. Isolate the hazard area and deny access to unnecessary personnel. Emergency personnel should stay out of low areas and ventilate closed spaces before entering. Cool containers from the sides with water until well after the fire is out. Stay away from the ends of containers. Firefighters should wear a full set of protective clothing and self-contained breathing apparatus when fighting fires involving ethylidene norbornene.

EXPOSURE LIMITS

- **OSHA PEL**

The Occupational Safety and Health Administration (OSHA) has not promulgated a permissible exposure limit (PEL) for ethylidene norbornene [29 CFR 1910.1000, Table Z-1].

- **NIOSH REL**

The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) of 5 ppm (25 mg/m³) as a ceiling limit

for ethylidene norbornene. The ceiling limit should not be exceeded during any part of the workday [NIOSH 1992].

- **ACGIH TLV**

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned ethylidene norbornene a ceiling limit value of 5 ppm (25 mg/m³), which should not be exceeded during any part of the working exposure [ACGIH 1993].

- **Rationale for limits**

The NIOSH limit is based on the risk of eye and skin irritation associated with ethylidene norbornene exposure and renal, urogenital, and bone marrow effects found in animals exposed to ethylidene norbornene [NIOSH 1992]. The ACGIH limit is based on the risk of eye and nose irritation associated with exposure to ethylidene norbornene [ACGIH 1991].

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Exposure to ethylidene norbornene can occur through inhalation, ingestion, and eye or skin contact.

- **Summary of toxicology**

1. *Effects on Animals:* Ethylidene norbornene causes irritation of the eyes and skin, as well as liver and testicular toxicity in animals. In contact with the skin of rabbits, ethylidene norbornene caused a mild degree of skin irritation [NIOSH 1994]. The dermal LD₅₀ in rabbits is 8,189 mg/kg [NIOSH 1994]. In contact with the eyes of rabbits, this substance produced transient conjunctival irritation [Grant 1986]. The 4-hr LC₅₀ is 1,246 ppm in rats and 732 ppm in mice [NIOSH 1994]. The oral LD₅₀ is 2,527 mg/kg in rats and 3,250 mg/kg in mice. Dogs exposed to a 93-ppm concentration of ethylidene norbornene for 7 hours/day, 5 days/week, for a total of 89 exposures showed slight blood changes and, at autopsy, hepatic lesions and testicular atrophy [Hathaway et al. 1991]. When dogs were exposed to a concentration of 61 ppm on the same regimen, less severe lesions of these organs were seen at post mortem. At an ethylidene norbornene concentration of 22 ppm, no damage was noted [Hathaway et al. 1991]. Twenty-one of twenty-four rats inhaling a 237-ppm concentration of ethylidene norbornene on the same schedule died. Liver

lesions, atrophy of the testicles, and hydrothorax were observed. No deaths occurred from 90 ppm, but liver lesions were evident [ACGIH 1991].

2. *Effects on Humans:* Ethylidene norbornene causes eye, nose, and upper respiratory tract irritation in humans. Volunteers exposed for 30 minutes to a 6-ppm concentration of ethylidene norbornene reported transient eye irritation, and, at a concentration of 11 ppm, both eye and nose irritation were experienced [ACGIH 1991]. In contact with the skin, ethylidene norbornene caused reddening and defatting [USCG 1991].

• **Signs and symptoms of exposure**

1. *Acute exposure:* The signs and symptoms of acute exposure to ethylidene norbornene include redness and inflammation of the eyes and eyelids, runny nose, scratchy throat, and redness and inflammation of the skin.

2. *Chronic exposure:* Repeated exposure to ethylidene norbornene may damage the liver, kidneys, and lungs in humans.

• **Emergency procedures:**

WARNING!

Seek immediate medical attention for severely affected victims or for victims with signs and symptoms of toxicity or irritation!

Keep unconscious victims warm and on their sides to avoid choking if vomiting occurs. Initiate the following emergency procedures:

1. *Eye exposure:* Irritation may result from exposures to concentrated solutions, vapors, mists, or aerosols of ethylidene norbornene. **Immediately and thoroughly** flush eyes with large amounts of water occasionally lifting the lower and upper eyelids.

2. *Skin exposure:* Irritation may result. **Immediately** remove contaminated clothing and **thoroughly** wash contaminated skin with soap and water.

3. *Inhalation exposure:* Move the victim to fresh air **immediately**.

If the victim is not breathing, clean any chemical con-

tamination from the victim's lips and perform cardiopulmonary resuscitation (CPR); if breathing is difficult, give oxygen.

4. *Ingestion exposure:* Take the following steps if ethylidene norbornene or any material containing it is ingested:

—Have the victim rinse the contaminated mouth cavity several times with a fluid such as water.

—Have the victim drink a glass (8 oz) of fluid such as water.

—Induce vomiting by giving syrup of ipecac as directed on the package. If ipecac is unavailable, have the victim touch the back of the throat with a finger until productive vomiting ceases.

—Do **not** force an unconscious or convulsing person to drink fluid or to vomit.

5. *Rescue:* Remove an incapacitated worker from further exposure and implement appropriate emergency procedures (e.g., those listed on the material safety data sheet required by OSHA's hazard communication standard [29 CFR 1910.1200]). All workers should be familiar with emergency procedures, the location and proper use of emergency equipment, and methods of protecting themselves during rescue operations.

EXPOSURE SOURCES AND CONTROL METHODS

The following operations may involve ethylidene norbornene and may lead to worker exposures to this substance:

—Manufacture of pharmaceuticals and pesticides

—Preparation of specialty resins

—Use as the third monomer in ethylene-propylene diene monomer elastomers

The following methods are effective in controlling worker exposures to ethylidene norbornene, depending on the feasibility of implementation:

—Process enclosure

—Local exhaust ventilation

—General dilution ventilation

—Personal protective equipment

Good sources of information on control methods are as follows:

1. ACGIH [1992]. *Industrial ventilation—a manual of recommended practice*. 21st ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
2. Burton DJ [1986]. *Industrial ventilation—a self study companion*. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
3. Alden JL, Kane JM [1982]. *Design of industrial ventilation systems*. New York, NY: Industrial Press, Inc.
4. Wadden RA, Scheff PA [1987]. *Engineering design for control of workplace hazards*. New York, NY: McGraw-Hill.
5. Plog BA [1988]. *Fundamentals of industrial hygiene*. Chicago, IL: National Safety Council.

MEDICAL MONITORING

Workers who may be exposed to chemical hazards should be monitored in a systematic program of medical surveillance that is intended to prevent occupational injury and disease. The program should include education of employers and workers about work-related hazards, early detection of adverse health effects, and referral of workers for diagnosis and treatment. The occurrence of disease 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 monitoring program is intended to supplement, not replace, such measures. To place workers effectively and to detect and control work-related health effects, medical evaluations should be performed (1) before job placement, (2) periodically during the term of employment, and (3) at the time of job transfer or termination.

• Preplacement medical evaluation

Before a worker is placed in a job with a potential for exposure to ethylidene norbornene, a licensed health care professional 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, upper respiratory tract, reproductive system, skin, liver, and kidneys. Medical monitoring for respiratory disease should be conducted using the principles and methods recommended by the American Thoracic Society [ATS 1987].

A preplacement medical evaluation is recommended to assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to ethylidene norbornene at or below the prescribed exposure limit. A licensed health care professional should consider the probable frequency, intensity, and duration of exposure as well as the nature and degree of any applicable medical condition. Such conditions (which should not be regarded as absolute contraindications to job placement) include a history and other findings consistent with diseases of the eyes, respiratory tract, skin, liver, or kidneys or disturbances in reproductive function.

• Periodic medical examinations and biological monitoring

Occupational health interviews and physical examinations should be performed at regular intervals during the employment period, as mandated by any applicable Federal, State, or local standard. Where no standard exists and the hazard is minimal, evaluations should be conducted every 3 to 5 years or as frequently as recommended by an experienced occupational health physician. Additional examinations may be necessary if a worker develops symptoms attributable to ethylidene norbornene exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of ethylidene norbornene on the eyes, respiratory tract, skin, liver, kidneys, or reproductive function. Current health status should be compared with the baseline health status of the individual worker or with expected values for a suitable reference population.

Biological monitoring involves sampling and analyzing body tissues or fluids to provide an index of exposure to a toxic substance or metabolite. No biological monitoring test acceptable for routine use has yet been developed for ethylidene norbornene.

• Medical examinations recommended at the time of job transfer or termination

The medical, environmental, and occupational history

interviews, the physical examination, and selected physiologic or laboratory tests that were conducted at the time of placement should be repeated at the time of job transfer or termination to determine the worker's medical status at the end of his or her employment. Any changes in the worker's health status should be compared with those expected for a suitable reference population.

WORKPLACE MONITORING AND MEASUREMENT

No sampling and analytical method is available to determine a worker's exposure to airborne ethylidene norbornene.

PERSONAL HYGIENE

If ethylidene norbornene contacts the skin, workers should flush the affected areas immediately with plenty of water for 15 minutes, and then wash with soap and water.

Clothing contaminated with ethylidene norbornene should be removed immediately, and provisions should be made for the safe removal of the chemical from the clothing. Persons laundering the clothes should be informed of the hazardous properties of ethylidene norbornene, particularly its potential to be irritating to the skin.

A worker who handles ethylidene norbornene should thoroughly wash hands, forearms, and face with soap and water before eating, using tobacco products, using toilet facilities, or applying cosmetics.

Workers should not eat, drink, use tobacco products, or apply cosmetics in areas where ethylidene norbornene or a solution containing ethylidene norbornene is handled, processed, or stored.

STORAGE

Ethylidene norbornene should be stored in a cool, dry, well-ventilated area in tightly sealed containers that are labeled in accordance with OSHA's hazard communication standard [29 CFR 1910.1200]. Ethylidene norbornene must be stored under an inert (oxygen free) atmosphere (i.e., a nitrogen atmosphere) or be stabilized with tert-butyl catechol. Containers of ethylidene norbornene should be protected from physical damage and should be stored away from oxygen, heat, sparks, and open flame. Because containers that formerly contained ethylidene norbornene may still hold product residues, they should be handled appropriately.

SPILLS AND LEAKS

In the event of a spill or leak involving ethylidene norbornene, persons not wearing protective equipment and clothing should be restricted from contaminated areas until cleanup has been completed. The following steps should be undertaken following a spill or leak:

1. Do not touch the spilled material; stop the leak if it is possible to do so without risk.
2. Notify safety personnel.
3. Remove all sources of heat and ignition.
4. Ventilate potentially explosive atmospheres.
5. Water spray may be used to reduce vapors.
6. For small dry spills, use a clean shovel and gently place the material into a clean, dry container, creating as little dust as possible; cover and remove the container from the spill area.
7. For small liquid spills, take up with sand or other noncombustible absorbent material and place into closed containers for later disposal.
8. For large liquid spills, build dikes far ahead of the spill to contain the ethylidene norbornene for later reclamation or disposal.

SPECIAL REQUIREMENTS

U.S. Environmental Protection Agency (EPA) requirements for emergency planning, reportable quantities of hazardous releases, community right-to-know, and hazardous waste management may change over time. Users are therefore advised to determine periodically whether new information is available.

• Emergency planning requirements

Ethylidene norbornene is not subject to EPA emergency planning requirements under the Superfund Amendments and Reauthorization Act (SARA) [42 USC 11022].

• Reportable quantity requirements for hazardous releases

Employers are not required by the emergency release notification provisions of the Comprehensive Environmental

Response, Compensation, and Liability Act (CERCLA) [40 CFR 355.40] to notify the National Response Center of an accidental release of ethylidene norbornene; there is no reportable quantity for this substance.

- **Community right-to-know requirements**

Employers are not required by Section 313 of SARA to submit a Toxic Chemical Release Inventory form (Form R) to EPA reporting the amount of ethylidene norbornene emitted or released from their facility annually.

- **Hazardous waste management requirements**

EPA considers a waste to be hazardous if it exhibits any of the following characteristics: ignitability, corrosivity, reactivity, or toxicity, as defined in 40 CFR 261.21-261.24. Although ethylidene norbornene is not specifically listed as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) [40 USC 6901 et seq.], EPA requires employers to treat any waste as hazardous if it exhibits any of the characteristics discussed above.

Providing detailed information about the removal and disposal of specific chemicals is beyond the scope of this guideline. The U.S. Department of Transportation, EPA, and State and local regulations should be followed to ensure that removal, transport, and disposal of this substance are conducted in accordance with existing regulations. To be certain that chemical waste disposal meets EPA regulatory requirements, employers should address any questions to the RCRA hotline at (800) 424-9346 or at (202) 382-3000 in Washington, D.C. In addition, relevant State and local authorities should be contacted for information about their requirements for waste removal and disposal.

RESPIRATORY PROTECTION

- **Conditions for respirator use**

Good industrial hygiene practice requires that engineering controls be used where feasible to reduce workplace concentrations of hazardous materials to the prescribed exposure limit. However, some situations may require the use of respirators to control exposure. Respirators must be worn if the ambient concentration of ethylidene norbornene exceeds prescribed exposure limits. Respirators may be used (1) before engineering controls have been installed, (2) during work operations such as

maintenance or repair activities that involve unknown exposures, (3) during operations that require entry into tanks or closed vessels, and (4) during emergencies. Workers should use only respirators that have been approved by NIOSH and the Mine Safety and Health Administration (MSHA).

- **Respiratory protection program**

Employers should institute a complete respiratory protection program that, at a minimum, complies with the requirements of OSHA's respiratory protection standard [29 CFR 1910.134]. Such a program must include respirator selection, an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, respirator fit testing, periodic workplace monitoring, and regular respirator maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program (including selection of the correct respirator) requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly. For additional information about the selection and use of respirators and about the medical screening of respirator users, consult the *NIOSH Respirator Decision Logic* [NIOSH 1987b] and the *NIOSH Guide to Industrial Respiratory Protection* [NIOSH 1987a].

PERSONAL PROTECTIVE EQUIPMENT

Protective clothing (gloves, boots, aprons, and gauntlets, as appropriate) should be worn to prevent skin contact with ethylidene norbornene. Chemical protective clothing should be selected on the basis of available performance data, manufacturers' recommendations, and evaluation of the clothing under actual conditions of use. No reports have been published on the resistance of various protective clothing materials to ethylidene norbornene permeation. If permeability data are not readily available, protective clothing manufacturers should be requested to provide information on the best chemical protective clothing for workers to wear when they are exposed to ethylidene norbornene.

Safety glasses, goggles, or face shields should be worn during operations in which ethylidene norbornene might contact the eyes (e.g., through splashes of solution). Eyewash fountains and emergency showers should be available within the immediate work area whenever the potential exists for eye or skin contact with ethylidene norbornene. Contact lenses should not be worn if the potential exists for ethylidene norbornene exposure.

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