

1,1-Dimethylhydrazine

57-14-7

Hazard Summary

1,1-Dimethylhydrazine is primarily used as a high-energy fuel in military applications and as a rocket propellant and fuel for thrusters. Acute (short-term) inhalation exposure of humans to 1,1-dimethylhydrazine results in nose and throat irritation, mild conjunctivitis, nausea, and vomiting. It is also highly corrosive and irritating to the skin, eyes, and mucous membranes. Liver damage in humans may occur from chronic (long-term) exposure to 1,1-dimethylhydrazine. No information is available on the reproductive, developmental, or carcinogenic effects of 1,1-dimethylhydrazine in humans. Carcinogenic effects have been observed in animals exposed to 1,1-dimethylhydrazine by inhalation and orally, predominantly to the lung and liver. EPA has not classified 1,1-dimethylhydrazine for potential carcinogenicity. The International Agency for Research on Cancer (IARC) has classified 1,1-dimethylhydrazine as a Group 2B, the chemical is possibly carcinogenic to humans.

Please Note: The main sources of information for this fact sheet are EPA's Health and Environmental Effects Profile for 1,1-Dimethylhydrazine (1), the International Agency for Research on Cancer (IARC) Monographs of the Carcinogenic Risk to Man of 1,1-Dimethylhydrazine (7), and The Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for Hydrazines. (8)

Uses

- 1,1-Dimethylhydrazine is primarily used as a high-energy fuel in military applications, as a rocket propellant and fuel for thrusters, and small electrical power generating units. (1)
- 1,1-Dimethylhydrazine is also used in the manufacture of a plant growth regulator, in chemical synthesis, in photographic chemicals, as a stabilizer for fuel additives, and as an absorbent for acid gases. (1)

Sources and Potential Exposure

- Individuals may be exposed to 1,1-dimethylhydrazine in the workplace. (1)
- Individuals may be exposed to 1,1-dimethylhydrazine in the ambient atmosphere from its use as rocket fuel and from spills, leaks, and venting during loading, transfer, and storage. (1)
- In the atmosphere, 1,1-dimethylhydrazine reacts with ozone and hydroxyl radicals to produce 1,1-dimethylnitrosamine, a potent carcinogen. (1)

Assessing Personal Exposure

- 1,1-Dimethylhydrazine can be measured in the blood, urine, and tissues of exposed persons. (8)

Health Hazard Information

Acute Effects:

- Acute inhalation exposure of humans to 1,1-dimethylhydrazine has been observed to result in nose and throat irritation, mild conjunctivitis, nausea, and vomiting. (2,3)
- 1,1-Dimethylhydrazine is highly corrosive and irritating to the skin, eyes, and mucous membranes, and neurological symptoms were observed in a man burned by 1,1-dimethylhydrazine. (2,4)
- Central nervous system (CNS) stimulation and convulsions have been reported in animals acutely exposed

to 1,1-dimethylhydrazine by ingestion. (3)

- Acute animal exposure tests in rats, mice, hamsters, rabbits, and guinea pigs, have demonstrated 1,1-dimethylhydrazine to have **high** acute toxicity from inhalation, oral, and dermal exposures. (5)

Chronic Effects (Noncancer):

- Liver damage in humans may occur from chronic (long-term) exposure to 1,1-dimethylhydrazine. (1,8)
- Hemolytic anemia and CNS effects, such as convulsive seizures, have been observed in animals chronically exposed to 1,1-dimethylhydrazine by inhalation (1-3,8)
- Respiratory and kidney effects have been observed in chronically exposed animals. (1,8)
- EPA has not established a Reference Concentration (**RfC**) or a Reference Dose (**RfD**) for 1,1-dimethylhydrazine. (6)
- ATSDR has established an intermediate inhalation minimal risk level (MRL) of 0.0005 milligrams per cubic meter (mg/m^3) (0.0002 ppm) based on liver effects in mice. The MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects over a specified duration of exposure. Exposure to a level above the MRL does not mean that adverse health effects will occur. The MRL is intended to serve as a screening tool. (8)

Reproductive/Developmental Effects:

- No information is available on the reproductive or developmental effects of 1,1-dimethylhydrazine in humans.
- Sperm abnormalities and decreased sperm counts were observed in animals injected with 1,1-dimethylhydrazine. (8)
- Birth defects were not observed in the offspring of animals exposed intraperitoneally to 1,1-dimethylhydrazine. (8)

Cancer Risk:

- No information is available on the carcinogenic effects of 1,1-dimethylhydrazine in humans.
- Carcinogenic effects were observed in mice and rats exposed to 1,1-dimethylhydrazine by inhalation, but the carcinogenicity could not be definitively attributed to 1,1-dimethylhydrazine because of the presence of contaminants in the study. However, in another study, rats exposed to 1,1-dimethylhydrazine by inhalation developed skin, lung, pancreas, pituitary, and liver tumors. (1,7,8)
- By oral exposure, 1,1-dimethylhydrazine is carcinogenic in mice and hamsters. Lung tumors, as well as kidney and liver tumors, have been observed in mice orally exposed to 1,1-dimethylhydrazine. A high incidence of angiosarcomas located in various organs was also observed in the mice. (1)
- EPA has not classified 1,1-dimethylhydrazine for potential carcinogenicity. (6)
- IARC has classified 1,1-dimethylhydrazine as a Group 2B, the chemical is possibly carcinogenic to humans. (7)

Physical Properties

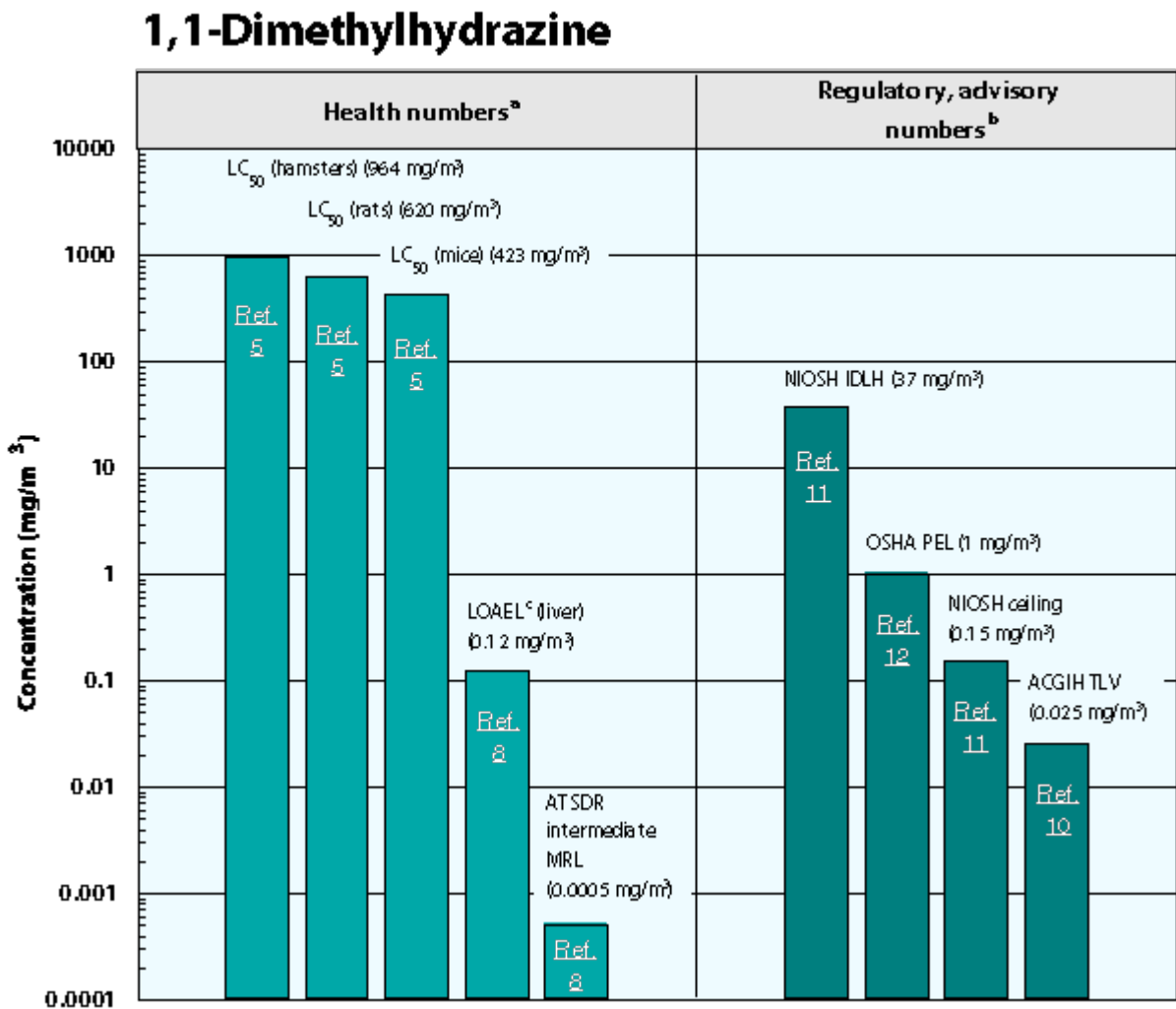
- The chemical formula for 1,1-dimethylhydrazine is $\text{C}_2\text{H}_8\text{N}_2$, and its molecular weight is 60.1 g/mol. (1,4,7)
- 1,1-Dimethylhydrazine is a colorless, flammable, hygroscopic liquid that gradually turns yellow upon contact with air and is miscible with water. (1,4,7)
- 1,1-Dimethylhydrazine has an ammonia-like fishy smell, with an odor threshold of 1.7 parts per million (ppm). (1,7,9)
- The vapor pressure for 1,1-dimethylhydrazine is 157 mm Hg at 25 °C. (1)

Conversion Factors:

To convert concentrations in air (at 25 °C) from ppm to mg/m^3 : $\text{mg}/\text{m}^3 = (\text{ppm}) \times (\text{molecular weight of the}$

compound)/(24.45). For 1,1-dimethylhydrazine: 1 ppm = 2.46 mg/m³.

Health Data from Inhalation Exposure



ACGIH TLV--American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.

LC₅₀ (Lethal Concentration ₅₀)--A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

NIOSH IDLH--National Institute of Occupational Safety and Health's immediately dangerous to life or health limit; NIOSH recommended exposure limit to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from the environment.

NIOSH REL ceiling--NIOSH's recommended exposure limit ceiling; the concentration that should not be exceeded at any time.

OSHA PEL--Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

The health and regulatory values cited in this factsheet were obtained in December 1999.

^a Health numbers are toxicological numbers from animal testing or risk assessment values developed by EPA.

^b Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. OSHA numbers are regulatory, whereas NIOSH and ACGIH numbers are advisory.

^c This LOAEL is from the critical study used as the basis for the ATSDR intermediate inhalation MRL.

References

Summary Created in April 1992, updated January 2000

1. U.S. Environmental Protection Agency. Health and Environmental Effects Profile for 1,1-Dimethylhydrazine. EPA/600/x-84/134. Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Office of Research and Development, Cincinnati, OH. 1984.
2. U.S. Department of Health and Human Services. Hazardous Substances Databank (HSDB, online database). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
3. G.D. Clayton and F.E. Clayton, Eds. Patty's Industrial Hygiene and Toxicology. Volume IIA. 3rd revised ed. John Wiley & Sons, New York. 1981.
4. The Merck Index. An Encyclopedia of Chemicals, Drugs, and Biologicals. 11th ed. Ed. S. Budavari. Merck and Co. Inc., Rahway, NJ. 1989.
5. U.S. Department of Health and Human Services. Registry of Toxic Effects of Chemical Substances (RTECS, online database). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
6. U.S. Environmental Protection Agency. Integrated Risk Information System (IRIS) on 1,1-Dimethylhydrazine. National Center for Environmental Assessment, Office of Research and Development, Washington, DC. 1999.
7. International Agency for Research on Cancer (IARC). IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man: Some Aromatic Amines, Hydrazine and Related Substances, N-Nitroso Compounds and Miscellaneous Alkylating Agents. Volume 4. World Health Organization, Lyon. 1974.
8. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Hydrazines. Public Health Service, U.S. Department of Health and Human Services, Atlanta, GA. 1997.
9. J.E. Amoore and E. Hautala. Odor as an aid to chemical safety: Odor thresholds compared with threshold limit values and volatilities for 214 industrial chemicals in air and water dilution. Journal of Applied Toxicology, 3(6):272-290. 1983.
10. American Conference of Governmental Industrial Hygienists (ACGIH). 1999 TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents. Biological Exposure Indices. Cincinnati, OH. 1999.
11. National Institute for Occupational Safety and Health (NIOSH). Pocket Guide to Chemical Hazards. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention. Cincinnati, OH. 1997.
12. Occupational Safety and Health Administration (OSHA). Occupational Safety and Health Standards, Toxic and Hazardous Substances. Code of Federal Regulations. 29 CFR 1910.1000. 1998.