

Occupational Health Guideline for Dimethylamine

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $(\text{CH}_3)_2\text{NH}$
- Synonyms: Dimethylamine, anhydrous
- Appearance and odor: Colorless liquid or gas with a pungent, fishy, or ammonia-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for dimethylamine is 10 parts of dimethylamine per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 18 milligrams of dimethylamine per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- Routes of exposure
Dimethylamine can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.
- Effects of overexposure
 1. *Short-term Exposure:* Dimethylamine vapor may cause irritation of the lungs, nose, throat, and eyes. It may cause coughing and sneezing. Contact with the liquid may cause skin and eye burns.
 2. *Long-term Exposure:* None known
 3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to dimethylamine.

- Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to dimethylamine at potentially hazardous levels:

1. *Initial Medical Screening:* Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from dimethylamine exposure.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of dimethylamine might cause exacerbation of symptoms due to its irritant properties.

—Skin disease: Dimethylamine is a primary skin irritant. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Eye disease: Dimethylamine is a severe eye irritant and may cause tissue damage. Those with pre-existing eye problems may be at increased risk from exposure.

2. *Periodic Medical Examination:* Any employee developing the above-listed conditions should be referred for further medical examination.

- Summary of toxicology

Dimethylamine gas is a severe respiratory, eye, and mucous membrane irritant in animals. Animals repeatedly exposed to concentrations of approximately 100 to 200 ppm for 18-20 weeks showed marked irritation of the respiratory tract with pulmonary edema as well as hepatic injury, including centrilobular necrosis; corneal injury was observed in guinea pigs and rabbits after 9 days of exposure. Various species survived 5 ppm of continuous exposure for 90 days without signs of toxicity, but at autopsy some showed mild inflammatory changes in the lungs. A drop of undiluted dimethylamine placed on a rabbit's cornea caused the cornea to become as white as the sclera in 1 minute. Both the liquid and the vapor are highly irritating to the eyes and may result in loss of visual acuity. Dermatitis and conjunctivitis are occasionally observed in chemical workers after prolonged exposure to the gas. No sys-

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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temic effects from industrial exposure have been reported.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 45.1
2. Boiling point (760 mm Hg): 6.9 C (44.4 F)
3. Specific gravity (water = 1): 0.68 (liquid at 0 C)
4. Vapor density (air = 1 at boiling point of dimethylamine): 1.6
5. Melting point: -92 C (-134 F)
6. Vapor pressure at 20 C (68 F): 1.72 atm.
7. Solubility in water, g/100 g water at 20 C (68 F): Very soluble
8. Evaporation rate (butyl acetate = 1): Greater than 1

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizers, chlorine, and mercury may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen and carbon monoxide) may be released in a fire involving dimethylamine.

4. Special precautions: Liquid dimethylamine will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: Not pertinent (gas)
2. Autoignition temperature: 402 C (755 F)
3. Flammable limits in air, % by volume: Lower: 2.8; Upper: 14.4
4. Extinguishant: Stop flow of gas.

• Warning properties

1. Odor Threshold: Summer reports that the odor threshold of dimethylamine is 6 ppm, and May reports two odor thresholds, .021 and 23 ppm.

2. Eye Irritation Level: The *Documentation of TLV's* reports that dimethylamine irritates mucous membranes. Repeated exposures of guinea pigs and rabbits to concentrations of 183 to 97 ppm dimethylamine have resulted in corneal injury. There is no available information on the threshold of eye irritation.

3. Other Information: The *Documentation of TLV's* states that dimethylamine is a mucous membrane irritant and a respiratory tract irritant. The thresholds of irritation are not given.

4. Evaluation of Warning Properties: Since the odor threshold ranges between one-five hundredth of the permissible exposure limit and approximately twice the permissible exposure limit, dimethylamine is treated as a material with good warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based

on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

Sampling and analyses may be performed by collection of vapors in a silica gel tube, followed by desorption with sulfuric acid in methanol, and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure dimethylamine may be used. An analytical method for dimethylamine is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with liquid dimethylamine.

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with solutions containing dimethylamine.

• Clothing wet with solutions containing dimethylamine should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of dimethylamine from the clothing. If the clothing is to be laundered or otherwise cleaned to

remove the dimethylamine, the person performing the operation should be informed of dimethylamine's hazardous properties.

- Where there is any possibility of exposure of an employee's body to liquid dimethylamine, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.
- Non-impervious clothing which becomes contaminated with liquid solutions of dimethylamine should be removed promptly and not reworn until the dimethylamine is removed from the clothing.
- Any clothing which becomes wet with liquid dimethylamine or liquid solutions of dimethylamine should be removed immediately and not reworn until the dimethylamine is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where there is any possibility of liquid dimethylamine or solutions containing dimethylamine contacting the eyes.
- Where there is any possibility that employees' eyes may be exposed to liquid dimethylamine or solutions containing dimethylamine, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes contaminated with liquid dimethylamine should be immediately washed or showered to remove any dimethylamine.
- Skin that becomes contaminated with solutions containing dimethylamine should be promptly washed or showered to remove any dimethylamine.
- Employees who handle dimethylamine or solutions containing dimethylamine should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to dimethylamine may occur and control methods which may be effective in each case:

Operation	Controls
Use in preparation of spinning solvents for acrylic and polymeric fibers	General dilution ventilation; local exhaust ventilation; personal protective equipment

Operation

Use as raw material in synthesis of agricultural chemicals; vulcanization accelerators for sulfur-cured rubber; softeners, lubricants; textile water-proofing agents; cationic surfactants; pharmaceuticals; detergents and soaps; as an antioxidant

Use as a general solvent; acid gas absorbent and flotation agent in manufacture of dyes and in electroplating

Use as photographic chemical, plasticizer, and ion exchange agent

Use as a stabilizer in natural rubber latex

Use as a stabilizer for certain types of resins (polymerization inhibitor)

Use as a retarder in spinning bath of rayon (for tire cord)

Use as a component of rocket propellants; as an antiknock agent in other fuels

Controls

Process enclosure; general dilution ventilation; personal protective equipment

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General dilution ventilation; local exhaust ventilation; personal protective equipment

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General dilution ventilation; local exhaust ventilation; personal protective equipment

General dilution ventilation; local exhaust ventilation

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If dimethylamine gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If dimethylamine gets on the skin, immediately flush the contaminated skin with water. If dimethylamine soaks through the clothing, remove the clothing immediately

and wash the skin with water. If irritation persists after washing, get medical attention.

- **Breathing**

If a person breathes in large amounts of dimethylamine, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

- **Swallowing**

When dimethylamine has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

- **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and 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.

SPILL, LEAK, AND DISPOSAL PROCEDURES

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

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

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. Stop flow of gas. If source of leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place in the open air, and repair the leak or allow the cylinder to empty.
4. If in the liquid form, allow to vaporize.

- **Waste disposal method:**

Dimethylamine may be disposed of by burning at a safe location or in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Dimethylamine," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.
- Manufacturing Chemists Association, Inc.: *Chemical Safety Data Sheet SD-57, Methylamines*, Washington, D.C., 1955.
- May, J.: "Solvent Odor Thresholds for the Evaluation of Solvent Odors in the Atmosphere," *Staub-Reinhalt*, 26:9, 385-389, 1966.
- Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.
- Spector, W. S. (Vols. I, II), Negherbon, W. O. (Vol. III), Grebe, R. M. (Vol. IV), and Dittmer, D. S. (Vol. V) (eds.): *Handbook of Toxicology*, Saunders, Philadelphia, 1956-1959.
- Summer, W.: *Odor Pollution of Air: Causes and Control*, L. Hill, London, 1975.

RESPIRATORY PROTECTION FOR DIMETHYLAMINE

Condition	Minimum Respiratory Protection* Required Above 10 ppm
Gas Concentration	
500 ppm or less	A chemical cartridge respirator with a full facepiece and cartridge(s) which provides protection against dimethylamine. A gas mask with a chin-style or a front- or back-mounted canister which provides protection against dimethylamine. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
2000 ppm or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 2000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against dimethylamine. Any escape self-contained breathing apparatus.

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

