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OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR DIISOPROPYLAMINE

INTRODUCTION

This guideline summarizes pertinent information about diisopropylamine 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 Recommendations may be superseded by new developments in these fields; readers are therefore advised to regard these recommendations as general guidelines and to determine whether new information is available.

SUBSTANCE IDENTIFICATION

* Formula

$C(6)()H(15)()N$

* Structure

(For Structure, see paper copy)

* Synonyms

DIPA, N-(1-methylethyl)-2-propanamine

* Identifiers

1. CAS No.: 108-18-9

2. RTECS No.: IM4025000

3. DOT UN: 1158 68

4. DOT label: Flammable Liquid

* Appearance and odor

Diisopropylamine is a colorless, flammable, volatile liquid with an odor like that of ammonia. The air odor threshold concentration for diisopropylamine is 1.8 parts per million (ppm) parts of air.

CHEMICAL AND PHYSICAL PROPERTIES

* Physical data

1. Molecular weight: 101.2
2. Boiling point (at 760 mm Hg): 84 degrees C (183 degrees F)
3. Specific gravity (water = 1): 0.72 at 20 degrees C (68 degrees F)
4. Vapor density: 3.5
5. Freezing point: -96 degrees C (-141 degrees F) Solidifies
6. Vapor pressure at 20 degrees C (68 degrees F): 60 mm Hg
7. Solubility: Slightly soluble in water; soluble in alcohol, ether, acetone, and benzene.
8. Evaporation rate: Data not available.

* Reactivity

1. Conditions contributing to instability: Heat or flames.
2. Incompatibilities: Contact between diisopropylamine and oxidizing materials or strong acids should be avoided.
3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen and carbon monoxide) may be released in a fire involving diisopropylamine.
4. Special precautions: None reported.

* Flammability

The National Fire Protection Association has assigned a flammability rating of 3 (severe fire hazard) to diisopropylamine.

1. Flash point: -6.7 degrees C (20 degrees F) (closed cup)
2. Autoignition temperature: 316 degrees C (600 degrees F)
3. Flammable limits in air (percent by volume): Lower, 1.1; upper, 7.1
4. Extinguishant: For small fires use dry chemical, carbon dioxide, water spray, or regular foam. Use water spray, fog, regular foam to fight large fires involving diisopropylamine.

Fires involving diisopropylamine should be fought upwind from the maximum distance possible. Keep unnecessary people away; isolate the hazard area and deny entry. Isolate the area for 1/2 mile in all directions if a tank, rail car, or tank truck is involved in the fire. Emergency personnel should stay out of low areas and ventilate closed spaces before entering. Vapors may travel to a source of ignition and flash back. Vapors are an explosion and poison hazard indoors, outdoors, or in sewers. Containers of diisopropylamine may explode in the heat of the fire and should be moved from the fire area if it is possible to do so safely. If this is not possible, cool fire exposed containers from the sides with water until well after the fire is out. Stay away from the ends of containers. Personnel should withdraw immediately if a rising sound from a venting safety device is heard or if there is discoloration of a container due to fire. Firefighters should wear a full set of protective clothing and self-contained breathing apparatus when fighting fires involving diisopropylamine.

EXPOSURE LIMITS

* OSHA PEL

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for diisopropylamine is 5 ppm (20 mg/m³) as an 8-hour time-weighted average (TWA) concentration. The OSHA PEL also bears a "Skin" notation, which indicates that the cutaneous route of exposure (including mucous membranes and eyes) contributes to overall exposure [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) for diisopropylamine of 5 ppm (20 mg/m³) as a TWA for up to a 10-hour workday and a 40-hour workweek. NIOSH also assigns a "Skin" notation to diisopropylamine [NIOSH 1992].

* ACGIH TLV

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned diisopropylamine a threshold limit value (TLV) of 5 ppm (21 mg/m³) as a TWA for a normal 8-hour workday and a 40-hour workweek. The ACGIH also assigns a "Skin" notation to diisopropylamine.

* Rationale for Limits

The NIOSH limit is based on the risk of respiratory and severe eye irritation [NIOSH 1992].

The ACGIH limit is based on the risk of vision disturbances and irritation of the respiratory passages.

HEALTH HAZARD INFORMATION

* Routes of Exposure

Exposure to diisopropylamine can occur through inhalation, ingestion, eye or skin contact, and absorption through the skin [Sittig 1991].

* Summary of toxicology

1. Effects on Animals: Diisopropylamine is a severe irritant of the respiratory tract, eyes, and skin, and it is highly toxic when inhaled or ingested [Hathaway et al. 1991; Sittig 1991]. The LD(50) for acute oral exposure in rats is 700 mg/kg; the dermal LD (50) in rabbits is 500 mg/kg [ACGIH 1991; NIOSH 1995]. Animals of several species exposed to 2,707 ppm diisopropylamine succumbed within 3 hours; cats, guinea pigs, and rabbits died in 72, 82, and 150 minutes, respectively. Death was caused by pulmonary edema and hemorrhage [Clayton and Clayton 1982; Sax and Lewis 1989; Hathaway et al. 1991]. Acute exposures to diisopropylamine vapors at levels above 600 ppm caused tearing and corneal clouding in several species of laboratory animals [ACGIH 1991; Clayton and Clayton 1982]. Cats and rats survived 40 7-hour exposure to 600 ppm, but all rabbits and half of the guinea pigs exposed on the same regimen died within 20 days [ACGIH 1991]. Both the vapor and the liquid cause eye injury. Exposure to the vapor led to corneal clouding and swelling; and a drop of the liquid in the eyes of rabbits resulted in a grade 8 injury on a scale of 1 to 10 [Grant 1986; NLM 1995].

2. Effects on Humans: Diisopropylamine is a severe eye irritant, and exposure to high concentrations is expected to cause pulmonary irritation and edema. Workers exposed to concentrations ranging from 20 to 50 ppm reported haziness of vision; in two instances, nausea and headache also occurred [Hathaway et al. 1991]. Diisopropylamine is highly alkaline and it is likely that the liquid splashed into the eye would cause permanent corneal injury; prolonged skin contact is likely to cause dermatitis [Clayton and Clayton 1982; Grant 1986; Hathaway et al. 1991].

* Signs and symptoms of exposure

1. Acute exposure: Several hours of exposure to low airborne concentrations (25-50 ppm) of diisopropylamine cause visual disturbances such as haziness. Liquid diisopropylamine splashed into the eye causes pain, tearing, and redness and may cause corneal clouding and permanent injury. If inhaled in high concentrations, diisopropylamine causes respiratory tract irritation with cough, shortness of breath, copious sputum production, and other signs and symptoms of pulmonary edema.

2. Chronic exposure: No signs or symptoms of chronic exposure to diisopropylamine have been reported in humans.

EMERGENCY MEDICAL PROCEDURES

* Emergency medical procedures: [NIOSH to supply]

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 diisopropylamine and lead to worker exposures to this substance:

- * The manufacture and transportation of diisopropylamine
- * Used in synthesis of corrosion inhibitors, dyes, pesticides, catalyst, and pharmaceuticals, such as antihypertensive drugs
- * Used as a delayed action vulcanization accelerator for sulfur-cured rubbers, as a catalyst for chemical synthesis of alkylene, and as a stabilizer for mesityl oxide cyanohydrin
- * Used as intermediate in the production of N,N-diisopropyl-2-benzothiazole-sulfenamide and diisopropyl ammonium nitrate [NLM 1995]

Methods that are effective in controlling worker exposures to diisopropylamine, depending on the feasibility of implementation, are as follows:

- * Process enclosure
- * Local exhaust ventilation
- * General dilution ventilation
- * Personal protective equipment

Workers responding to a release or potential release of a hazardous substance must be protected as required by paragraph (q) of OSHA's Hazardous Waste Operations and Emergency Response Standard [29 CFR 1910.120].

Good sources of information about 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 SURVEILLANCE

OSHA is currently developing requirements for medical surveillance. When these requirements are promulgated, readers should refer to them for additional information and to determine whether employers whose employees are exposed to diisopropylamine are required to implement medical surveillance procedures.

*** Medical Screening**

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 surveillance program is intended to supplement, not replace, such measures. 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 diisopropylamine, 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 skin and respiratory system. Medical surveillance for respiratory disease should be conducted using the principles and methods recommended by the American Thoracic Society.

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 diisopropylamine at or below the prescribed exposure limit. The 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 skin or respiratory system.

*** Periodic medical evaluations**

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 diisopropylamine exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of diisopropylamine on the skin or respiratory system. Current health status should be compared with the baseline health status of the individual worker or with expected values for a suitable reference population.

*** Termination medical evaluations**

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.

* Biological monitoring

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 diisopropylamine.

WORKPLACE MONITORING AND MEASUREMENT

Determination of a worker's exposure to airborne diisopropylamine is made using a midget impinger containing 10 milliliters 0.1N H₂SO₄. Samples are collected at a maximum flow rate of 1 liter/minute until a maximum collection volume of 120 liters is reached. Analysis is conducted by gas chromatography using a flame ionization detector (GC/FID). This method is fully validated and is described in the OSHA Computerized Information System [OSHA 1994] and in NIOSH Method No. S-141 [NIOSH 1994b].

PERSONAL HYGIENE PROCEDURES

If diisopropylamine contacts the skin, workers should immediately wash the affected areas twice with soap and water.

Clothing contaminated with diisopropylamine 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 diisopropylamine, particularly its potential for causing systemic effects through dermal absorption.

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

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

STORAGE

Diisopropylamine 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]. Outside or detached storage is preferred. If stored inside, a flammable liquids storage cabinet should be used. Containers of diisopropylamine should be protected from physical damage and ignition sources, and should be stored separately from oxidizing materials or strong acids should be avoided.

SPILLS AND LEAKS

In the event of a spill or leak involving diisopropylamine, 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. Notify safety personnel.
2. Remove all sources of heat and ignition.
3. Ventilate potentially explosive atmospheres.

4. Do not touch the spilled material; stop the leak if it is possible to do so without risk.
5. Use non-sparking tools.
6. Water spray may be used to reduce vapors, but the spray may not prevent ignition in closed spaces.
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 diisopropylamine 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

Diisopropylamine is not subject to EPA emergency planning requirements under the Superfund Amendments and Reauthorization Act (SARA) (Title III) in 42 USC 11022.

* Reportable quantity requirements for hazardous releases

A hazardous substance release is defined by EPA as any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (including the abandonment or discarding of contaminated containers) of hazardous substances. In the event of a release that is above the reportable quantity for that chemical, employers are required to notify the proper Federal, State, and local authorities [40 CFR 355.40].

Employers are not required by the emergency release notification provisions in 40 CFR Part 355.40 to notify the National Response Center of an accidental release of diisopropylamine; there is no reportable quantity for this substance.

* Community right-to-know requirements

Employers are not required by EPA in 40 CFR Part 372.30 to submit a Toxic Chemical Release Inventory form (Form R) to EPA reporting the amount of diisopropylamine 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. Under the Resource Conservation and Recovery Act (RCRA) [40 USC 6901 et seq.], EPA has specifically listed many chemical wastes as hazardous. Although diisopropylamine is not specifically listed as a hazardous waste under RCRA, EPA requires employers to treat 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 (703) 412-9810 (in the Washington, D.C. area) or toll-free at

(800) 424-9346 (outside Washington, D.C.). In addition, relevant State and local authorities should be contacted for information on any requirements they may have for the waste removal and disposal of this substance.

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 diisopropylamine 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 only use 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 on the selection and use of respirators and on the medical screening of respirator users, consult the latest edition of the NIOSH Respirator Decision Logic [NIOSH 1987b] and the NIOSH Guide to Industrial Respiratory Protection [NIOSH 1987a].

PERSONAL PROTECTIVE EQUIPMENT

Workers should use appropriate personal protective clothing and equipment that must be carefully selected, used, and maintained to be effective in preventing skin contact with diisopropylamine. The selection of the appropriate personal protective equipment (PPE) (e.g., gloves, sleeves, encapsulating suits) should be based on the extent of the worker's potential exposure to diisopropylamine. The resistance of various materials to permeation by diisopropylamine is shown below:

Material	Breakthrough time (hr)
teflon	>8
viton	>8
nitrile rubber	Caution 1 to 4
butyl rubber	<1(*)
natural rubber	<1(*)
neoprene	<1(*)
polyvinyl chloride	<1(*)

(*) Not recommended, degradation may occur

To evaluate the use of these PPE materials with diisopropylamine, users should consult the best available performance data and manufacturers' recommendations. Significant differences have been demonstrated in the chemical resistance of generically similar PPE materials (e.g., butyl) produced by different manufacturers. In addition, the chemical resistance of a mixture may be significantly different from that of any of its neat components.

Any chemical-resistant clothing that is used should be periodically evaluated to determine its effectiveness in preventing dermal contact. Safety showers and eye wash stations should be located close to operations that involve diisopropylamine.

Splash-proof chemical safety goggles or face shields (20 to 30 cm long, minimum) should be worn during any operation in which a solvent, caustic, or other toxic substance may be splashed into the eyes.

In addition to the possible need for wearing protective outer apparel (e.g., aprons, encapsulating suits), workers should wear work uniforms, coveralls, or similar full-body coverings that are laundered each day. Employers should provide lockers or other closed areas to store work and street clothing separately. Employers should collect work clothing at the end of each work shift and provide for its laundering. Laundry personnel should be informed about the potential hazards of handling contaminated clothing and instructed about measures to minimize their health risk.

Protective clothing should be kept free of oil and grease and should be inspected and maintained regularly to preserve its effectiveness.

Protective clothing may interfere with the body's heat dissipation, especially during hot weather or during work in hot or poorly ventilated work environments.

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