

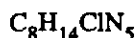
OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR ATRAZINE

INTRODUCTION

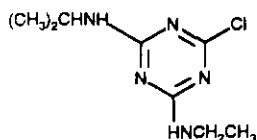
This guideline summarizes pertinent information about atrazine for workers and employers as well as for physicians, industrial hygienists, and other occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether new information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

Aatrex; Atranex; Atratol A; Atred; 2-chloro-4-ethylamino-6-isopropylamino-s-triazine; 6-chloro-N-ethyl-N'-(1-methylethyl)-1,3,5-triazine-2,4-diamine; Crisatrina; Fenamin; Gesaprim; Griffex; Hungazin; Inakor; Primatol; Radazin; Shell Atrazine Herbicide; Strazine; Triazine A1294; Vectral; Weedex A; Zeazine

• Identifiers

1. CAS No.: 1912-24-9
2. RTECS No.: XY5600000
3. DOT UN: 2763 53
4. DOT label: Poison

• Appearance and odor

Atrazine is an odorless, nonflammable, colorless or white, crystalline solid. This chemical is a triazine herbicide that is available commercially as a wettable powder or a liquid emulsion and is often combined with other herbicides.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 215.72
2. Boiling point (760 mm Hg): Not applicable
3. Specific gravity (water = 1): 1.19 at 20°C (68°F)
4. Vapor density: Data not available
5. Melting point: 171° to 174°C (339.8° to 345.2°F)
6. Vapor pressure at 20°C (68°F): 0.0000003 mm Hg
7. Solubility: Slightly soluble in water; soluble in diethyl ether, methanol, chloroform, dimethyl sulfoxide, ethyl acetate, and n-pentane
8. Evaporation rate: Data not available

• Reactivity

1. Conditions contributing to instability: Heat. Atrazine is very stable; it has a shelf life of several years but is slightly sensitive to natural light and extreme temperatures.
2. Incompatibilities: None
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide, hydrogen chloride, and oxides of nitrogen) may be released in a fire involving atrazine.
4. Special precautions: None

• Flammability

The National Fire Protection Association has not assigned a flammability rating to atrazine; this substance is not flammable.

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Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health
Division of Standards Development and Technology Transfer

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

1. Flash point: Not applicable
2. Autoignition temperature: Not applicable
3. Flammable limits in air: Not applicable
4. Extinguishant: Use an extinguishant that is suitable for the materials involved in the surrounding fire.

Fires involving atrazine should be fought upwind and 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. Firefighters should wear a full set of protective clothing (including a self-contained breathing apparatus) when fighting fires involving atrazine. Firefighters' protective clothing may not provide protection against permeation by atrazine.

EXPOSURE LIMITS

• OSHA PEL

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for atrazine is 5 mg/m³ of air as an 8-hr time-weighted average (TWA) [29 CFR 1910.1000, Table Z-1-A].

• NIOSH REL

The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) of 5 mg/m³ as an 8-hr TWA [NIOSH 1992].

• ACGIH TLV®

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned atrazine a threshold limit value (TLV) of 5 mg/m³ as a TWA for a normal 8-hr workday and a 40-hr workweek [ACGIH 1991b].

• Rationale for limits

The OSHA and NIOSH limits are based on the risk of neuropathic and metabolic effects associated with exposure to atrazine. The ACGIH limit is based on the acute effects of exposure to atrazine.

HEALTH HAZARD INFORMATION

• Routes of exposure

Exposure to atrazine can occur through inhalation, ingestion, or skin contact.

• Summary of toxicology

1. *Effects on Animals:* Atrazine is an irritant of the eyes and skin in animals; at high doses, it causes nervous system effects. Eyelid edema and conjunctivitis occurred after application of atrazine to the eyes of guinea pigs, cats, and rabbits [NLM 1991]. In separate studies, it also induced severe eye irritation when applied to the eyes of rabbits

[NIOSH 1991] and caused mild irritation when applied to their skin [NIOSH 1991]. The dermal LD₅₀ in rabbits is 7,500 mg/kg [NIOSH 1991]. When applied to the skin of rats, atrazine caused marked erythema but no systemic toxicity [Hayes 1982]. Groups of rats that inhaled atrazine aerosol concentrations (80% wettable powder) ranging from 1,800 to 4,900 mg/m³ for 1 hr developed no signs or symptoms of toxicity [NLM 1991]. The LC₅₀ in rats is 5,200 mg/m³ for 4 hr [NIOSH 1991]. The oral LD₅₀ in mice is 1,750 mg/kg [NLM 1991]. The oral LD₅₀ in rats ranges from 672 mg/kg [NIOSH 1991] to 3,080 mg/kg [NLM 1991]. Oral administration of a large amount of atrazine to rats caused them to develop muscular weakness, hypoactivity, ptosis, dyspnea, and prostration [NLM 1991]. The effects induced in rats following oral administration of the LD₁₀₀ (3,000 mg/kg) included depression, reduced respiratory rate, motor incoordination, clonic/tonic convulsions, hypothermia, and central nervous system lesions (undefined) [NLM 1991]. Rats receiving atrazine by gavage (100, 200, or 400 mg/kg per day for 7 or 14 days) showed a dose-dependent increase in liver weight and histopathological changes in the liver [NLM 1991]. Forty percent of rats that received 20 mg/kg per day for 6 months developed bronchitis, peribronchitis, respiratory distress, pericapillary edema, and dystrophy of the brain before death [NLM 1991]. In addition, rats receiving either 10 or 50 mg/kg per day for 6 months by gavage had inhibited growth rates, leukopenia, and disturbances in vitamin metabolism [NLM 1991]. Atrazine is embryotoxic at high, maternally toxic oral doses [NLM 1991]. Some carcinogenicity bioassays with atrazine have been positive [NLM 1991]. Atrazine is mutagenic in several mammalian test systems, including human fibroblasts [NIOSH 1991; NLM 1991]. Oral administration of atrazine for up to 2 yr did not induce cancers in treated mice or rats [ACGIH 1991a; NLM 1991].

2. *Effects on Humans:* In humans, atrazine causes skin irritation [NLM 1991]. No toxicity resulted when a child ingested 800 mg or when an adult ingested 4 mg/kg [NLM 1991]. A farmer who sprayed an atrazine formulation reported a case of severe contact dermatitis; he had red, swollen hands and bloody blisters between the fingers. A patch test later showed the farmer to be sensitized to atrazine [Hayes 1982]. Atrazine may also be mutagenic in humans: lymphocytes of agricultural workers exposed to atrazine showed a statistically significant increase in the incidence of chromosomal aberrations during the spraying season [EPA 1987]. Some evidence suggests that exposure to triazine herbicides increases the risk of ovarian cancer in exposed women [NLM 1991].

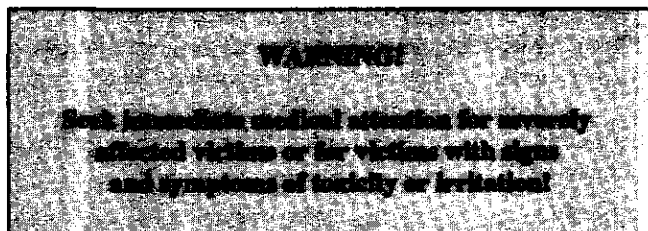
• Signs and symptoms of exposure

1. *Acute exposure:* Acute exposure to atrazine can cause severe irritation of the eyes and mild skin irritation. Mus-

cular weakness, hypoactivity, ptosis, dyspnea, prostration, depression, reduced respiratory rate, motor incoordination, clonic/tonic convulsions, and hypothermia have also been reported in atrazine-exposed animals.

2. **Chronic exposure:** Chronic exposure of animals to atrazine has produced tissue irritation and inhibited growth rates.

• **Emergency procedures**



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

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

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

3. **Inhalation exposure:** If particulates, vapors, mists, or aerosols of atrazine are inhaled, move the victim to fresh air *immediately*.

If the victim is not breathing, clean any chemical contamination from the victim's lips and perform cardiopulmonary resuscitation (CPR); if breathing is difficult, give oxygen.

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

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

—Induce vomiting by having the victim touch the back of the throat with a finger until productive vomiting ceases. Do *not* give syrup of ipecac because of possible onset of seizures.

—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 emergen-

cy procedures and the location and proper use of emergency equipment.

EXPOSURE SOURCES AND CONTROL METHODS

The following uses of atrazine may result in worker exposures to this substance:

—Use in the manufacture, formulation, or application of herbicides

—Use as a selective herbicide for control of broadleaf and grassy weeds in corn, sorghum, sugarcane, pineapple, asparagus, tomato, and potato fields; macadamia orchards; conifer reforestation sites; Christmas tree plantations; and grass seed fields

—Use as a nonselective herbicide (at higher concentrations) for industrial and commercial noncropped sites such as railroads, storage yards, and highways

—Use as an algicide in lakes and ponds

—Use as a turf grass sod herbicide

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

—Process enclosure

—Local exhaust ventilation

—General dilution ventilation

—Personal protective equipment

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 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, placement of workers in jobs that do not jeopardize their safety or health, 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 atrazine, 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 on a history of skin allergies.

A preplacement medical evaluation is recommended to assess an individual's suitability for employment at a specific job and to detect and assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to atrazine at or below the prescribed exposure limit. The 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 skin diseases.

- **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 atrazine exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of atrazine on the skin. 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 atrazine.

- **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 job placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared with those expected for a suitable reference population.

WORKPLACE MONITORING AND MEASUREMENT

A worker's exposure to airborne atrazine is determined by using a glass fiber filter. Samples are collected at a maximum flow rate of 1 liter/min until a maximum air volume of 240 liters is collected. Analysis is conducted by high-pressure liquid chromatography using an ultraviolet detector. This method is described in the OSHA Computerized Information System [OSHA 1990] and in the OSHA Laboratory In-House Methods File [OSHA 1991].

PERSONAL HYGIENE

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

Clothing and shoes contaminated with atrazine should be removed immediately, and provisions should be made for safely removing this chemical from these articles. Persons laundering contaminated clothing should be informed of the hazardous properties of atrazine, particularly its potential for causing skin irritation.

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

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

STORAGE

Atrazine 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]. Containers of atrazine should be protected from physical damage and should be stored separately from heat, sparks, and open flame. Because containers that formerly

contained atrazine may still hold product residues, they should be handled appropriately.

SPILLS AND LEAKS

In the event of a spill or leak involving atrazine, persons not wearing protective equipment and clothing should be restricted from contaminated areas until cleanup is complete. The following steps should be undertaken following a spill or leak:

1. Do not touch the spilled material.
2. Notify safety personnel.
3. Ventilate the area of the spill or leak.
4. For small dry spills, use a clean shovel and place the material in a clean, dry container; cover and remove the container from the spill area.
5. Absorb small liquid spills with sand or other noncombustible absorbent material and place the material in a covered container for later disposal.
6. For large liquid spills, build dikes far ahead of the spill to contain the atrazine 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

Atrazine 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 atrazine; there is no reportable quantity for this substance.

• Community right-to-know requirements

Employers are not required by Section 313 of the SARA to submit a Toxic Chemical Release Inventory Form (Form R) to EPA reporting the amount of atrazine 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 atrazine 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 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 atrazine 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, 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 *NIOSH Respirator Decision Logic* [NIOSH 1987b] and the *NIOSH Guide to Industrial Respiratory Protection* [NIOSH 1987a].

PERSONAL PROTECTIVE EQUIPMENT

Gloves and protective clothing should be worn to prevent skin contact with atrazine. 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 permeation by atrazine formulations. 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 atrazine.

If atrazine is dissolved in an organic solvent, the permeation properties of both the solvent and the mixture must be considered when selecting personal protective equipment and clothing.

Safety glasses, goggles, or face shields should be worn during operations in which atrazine might contact the eyes (e.g., through dust particles or 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 atrazine. Contact lenses should not be worn if the potential exists for atrazine exposure.

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