

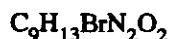
OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR BROMACIL

INTRODUCTION

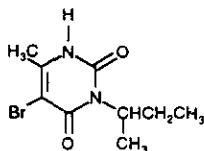
This guideline summarizes pertinent information about bromacil for workers and employers as well as for physicians, industrial hygienists, and other occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether new information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

Borea; bromazil; 5-bromo-6-methyl-3-(1-methyl propyl)-2,4(1H,3H)-pyrimidinedione; 5-bromo-6-methyl-3-(1-methylpropyl)-uracil; 5-bromo-3-sec-butyl-6-methyl-uracil; Cynogan; Eerex Granular Weed Killer; Eerex Water Soluble Concentrate Weed Killer; Herbicide 976; Hyvar; Hyvarex; isocil; Krovar II; Nalkil; Uragan; Uragon; Urox B.

• Identifiers

1. CAS No.: 314-40-9
2. RTECS No.: YQ9100000
3. DOT UN: None
4. DOT label: None

• Appearance and odor

Bromacil is a nonflammable, odorless, colorless-to-white, crystalline substance. It is commercially available as a wettable powder, liquid formulation, and mixture with various other agricultural chemicals. Bromacil-containing mixtures and liquid formulations may be combustible.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 261.11
2. Boiling point (760 mm Hg): Not applicable
3. Specific gravity (water = 1): 1.55 at 25°C (77°F)
4. Vapor density: Data not available
5. Melting point: 157.5° to 160°C (313.7° to 320°F): slowly sublimes
6. Vapor pressure at 100°C (212°F): 0.0008 mm Hg
7. Solubility: Slightly soluble in water; moderately soluble in xylene, strong aqueous bases, acetone, acetonitrile, and ethanol; sparingly soluble in hydrocarbons.
8. Evaporation rate: Data not available

• Reactivity

1. Conditions contributing to instability: Heat, sparks, and open flame.
2. Incompatibilities: Decomposes slowly upon contact with strong acids.
3. Hazardous decomposition products: Toxic gases (such as bromine and oxides of nitrogen) may be released in a fire involving bromacil.

4. Special precautions: None

• Flammability

The National Fire Protection Association has not assigned a flammability rating to bromacil. It may burn in its solid form,

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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

but it does not ignite easily. Liquid formulations or mixtures containing bromacil may be combustible.

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

Firefighters should wear a full set of protective clothing (including a self-contained breathing apparatus) when fighting fires involving bromacil.

EXPOSURE LIMITS

• OSHA PEL

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for bromacil is 1 ppm (10 mg/m³) as an 8-hr time-weighted average (TWA) concentration [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 1 ppm (10 mg/m³) as an 8-hr TWA [NIOSH 1992].

• ACGIH TLV®

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned bromacil a threshold limit value (TLV) of 1 ppm (10 mg/m³) as a TWA for a normal 8-hr workday and a 40-hr workweek [ACGIH 1991b].

• Rationale for limits

The limits are based on the risk of thyroid-damaging and irritant effects associated with exposure to bromacil.

HEALTH HAZARD INFORMATION

• Routes of exposure

Exposure to bromacil can occur through inhalation or ingestion.

• Summary of toxicology

1. *Effects on animals:* Bromacil is an irritant of the eyes and upper respiratory tract in experimental animals; this substance has also been shown to have endocrine and reproductive effects in rodents. When instilled into the eyes of rabbits, this substance caused reversible conjunctival irritation but no corneal damage [Grant 1986]. When applied to the skin of guinea pigs, bromacil caused mild to moderate irritation but was not a skin sensitizer [Clayton and Clayton 1981]. The dermal LD₅₀ in rabbits is greater than 5 g/kg [NIOSH 1991]. The oral LD₅₀ in rats is 641 mg/kg and does not induce signs or symptoms. Acute administration of 1,100 mg/kg to dogs

induced salivation, vomiting, muscular weakness, excitability, diarrhea, and mydriasis. Chickens and cattle developed weight loss and abnormal gait following an oral dose of 250 mg/kg. Toxic symptoms in poisoned animals include anorexia, depression, tympanites, and increased respiratory rates. One dog survived a 5 g/kg dose [NLM 1992]. Male rats were given bromacil 5 days/week for 2 weeks at oral doses of 650, 1,035, or 1,500 mg/kg; 5 of 6 rats died after 5 doses at the highest level, 1 died after 10 doses at 1,035 mg/kg, and no animal died at the lowest dose. At autopsy, focal cell hypertrophy and hyperplasia of the liver were seen [NRC 1977]. Rats were fed bromacil at 50, 500, 2,500, 5,000, 6,000, or 7,000 ppm for 90 days; those in the 5,000-ppm or higher groups developed hyperthyroidism [NRC 1977]. In another study, rats were fed bromacil at 50, 250, or 1,250 ppm for 2 years; those in the 1,250-ppm group developed hyperplasia of the thyroid, and one female rat also developed a follicular adenoma [NRC 1977]. When pregnant rats were exposed by inhalation to 38 mg/m³ (3.8 ppm) for 2 hr/day on gestation days 7 through 14, they developed reproductive, embryotoxic, and developmental effects [NIOSH 1991]. Conversely, rabbits that ingested diets containing 50 to 250 ppm bromacil during days 8 through 16 of pregnancy delivered normal pups. A three-generation rat study also demonstrated a lack of induced developmental toxicity [NLM 1992]. Contradictory mutagenicity results have been published for bromacil [NLM 1992]. A 2-yr chronic dietary study in rats did not result in cancer induction but did demonstrate that bromacil caused thyroid hyperplasia [NRC 1977]. All rats exposed to 4,800 mg/m³ (480 ppm) bromacil for 4 hr survived [ACGIH 1991a].

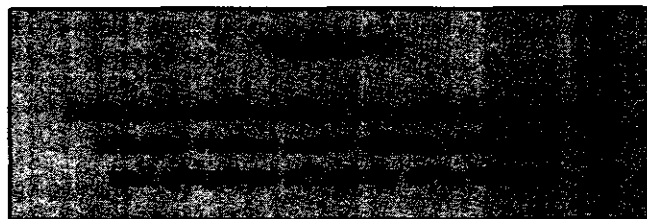
2. *Effects on humans:* Bromacil is known to cause eye, nose, and throat irritation in workers handling formulations containing this substance. Skin irritation has also been reported [NLM 1992; NJDH 1985]. There are no reports of bromacil-induced systemic toxicity.

• Signs and symptoms of exposure

1. *Acute exposure:* Acute exposure to bromacil dust can cause redness and itching of the eyes, runny nose, scratchy throat, and redness, dryness, and cracking of the skin.

2. *Chronic exposure:* No signs or symptoms of chronic bromacil exposure have been reported.

• 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 to concentrated solutions, vapors, mists, or aerosols of bromacil. **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 or vapors, mists, or aerosols of bromacil 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 bromacil 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 and the location and proper use of emergency equipment.

EXPOSURE SOURCES AND CONTROL METHODS

The following operations involve bromacil and may result in worker exposures to this substance:

—Manufacture or formulation of bromacil

—Use of bromacil as a herbicide to control annual and perennial grasses and broadleaf weeds

—Use of bromacil on noncrop lands as a nonselective herbicide and on a few crops (pineapple and citrus) as a selective herbicide

The following methods are effective in controlling worker exposures to bromacil, 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 bromacil, 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 tract. 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 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 bromacil at or below the prescribed exposure limit. The examining physician 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 or upper respiratory tract 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 bromacil exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of bromacil on the skin and respiratory tract. 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 bromacil.

- **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 bromacil is determined by using a midget impinger containing 15 ml of ethylene glycol. Samples are collected at a maximum flow rate of 1 liter/min until a maximum air volume of 50 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 1989].

PERSONAL HYGIENE

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

Clothing and shoes contaminated with bromacil 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 bromacil, particularly its potential to cause irritation.

A worker who handles bromacil 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 bromacil is handled, processed, or stored.

STORAGE

Bromacil 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 bromacil should be protected from physical damage and should be stored separately from strong acids and heat. Because containers that formerly contained bromacil may still hold product residues, they should be handled appropriately.

SPILLS AND LEAKS

In the event of a spill or leak involving bromacil, 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; 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 the area of the spill or leak.

5. For dry spills, use a clean shovel and place the material into a clean, dry container; cover and remove the container from the spill area.

6. Absorb any spilled liquid containing bromacil with sand or other noncombustible absorbent material and place the material in a covered container for later 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

Bromacil 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 bromacil; 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 bromacil 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 bromacil 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 bromacil 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

Protective clothing should be worn to prevent skin contact with bromacil. One source suggests wearing protective gloves and clothing when handling this substance. 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 formulations containing bromacil. If permeability data are not readily available, protective clothing manufacturers should be requested to provide information on the best chemical protec-

tive clothing for workers to wear when they are exposed to bromacil.

If bromacil is dissolved in water or 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 bromacil 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 bromacil. Contact lenses should not be worn if the potential exists for bromacil exposure.

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