

Occupational Health Guideline for Endrin

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: $C_{12}H_6Cl_6O$
- Synonyms: 1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo-endo-5,8-dimethanonaphthalene
- Appearance and odor: Colorless to tan solid with a mild chemical odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for endrin is 0.1 milligram of endrin per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

• Routes of exposure

Endrin can affect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed. It may enter the body through the skin.

• Effects of overexposure

Exposure to endrin may cause sudden convulsions which may occur from 30 minutes to 10 hours after exposure. Headache, dizziness, sleepiness, weakness, and loss of appetite may be present for two to four weeks following this exposure. A number of deaths have occurred from swallowing endrin. In less severe cases of endrin poisoning, the complaints include headache, dizziness, abdominal discomfort, nausea, vomiting, insomnia, agitation, and mental confusion. Experimental feeding of endrin to animals has produced abnormalities in their offspring.

• 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 endrin.

• Recommended medical surveillance

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

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a history of convulsive disorders would be expected to be at increased risk from exposure. Examination of the nervous system and liver should be stressed. The concentration of endrin in the blood is helpful in determining the extent of absorption.

2. Periodic Medical Examination: The aforementioned medical examination should be repeated on an annual basis.

• Summary of toxicology

Endrin as the dust or in solution is a convulsant. Single doses of 2.5 mg/kg of endrin administered orally to pregnant golden hamsters during the period of fetal organogenesis caused a high incidence of fetal deaths, congenital anomalies, and growth retardation. Rats fed a diet of 50 or 100 ppm endrin for 2 years developed degenerative changes in the liver. In humans, the first effect of endrin intoxication is frequently a sudden epileptiform convulsion, which may occur from 30 minutes to up to 10 hours after overexposure; it lasts for several minutes and is usually followed by a stuporous state for 15 minutes to 1 hour. The electroencephalogram may show dysrhythmic changes which frequently precede convulsions; withdrawal from exposure usually results in a normal electroencephalogram within 1 to 6 months. In most cases recovery is rapid, but headache, dizziness, lethargy, weakness, and anorexia may persist

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.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

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

for 2 to 4 weeks. In less severe cases of endrin intoxication, the complaints are headache, dizziness, abdominal discomfort, nausea, vomiting, insomnia, agitation and, occasionally, slight mental confusion. There are numerous reports of fatalities from ingestion of endrin. In one nonfatal incident, ingestion of bread made with endrin-contaminated flour resulted in sudden convulsions in three people; in one person the serum endrin level was 0.053 ppm 30 minutes after the convulsion and 0.038 ppm after 20 hours; in the other two cases no endrin was detected in the blood at 8.5 or 19 hours, respectively, after convulsions.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 380.9
2. Boiling point (760 mm Hg): Decomposes
3. Specific gravity (water = 1): 1.7
4. Vapor density (air = 1 at boiling point of endrin): Not applicable
5. Melting point: 200 C (392 F) decomposes
6. Vapor pressure at 20 C (68 F): 0.0000002 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 160 ppb
8. Evaporation rate (butyl acetate = 1): Not applicable

• Reactivity

1. Conditions contributing to instability: Temperatures above 200 C (392 F) cause a chemical change that gives off heat and may cause containers to burst. If a solvent is present, flammable vapors may be formed from it.

2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions. Contact with strong acids may cause evolution of heat and formation of explosive solvent vapors.

3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, other volatile chlorinated compounds, and carbon monoxide) may be released when endrin decomposes.

4. Special precautions: None

• Flammability

1. Solid not combustible; may be dissolved in flammable solvent

• Warning properties

Since the vapor pressure of endrin is negligible, warning properties are not considered.

Endrin is not known to be an eye irritant.

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

An analytical method for endrin is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 6, 1980, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00369-6).

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 endrin or liquids containing endrin.
- If employees' clothing has had any possibility of being contaminated with endrin or liquids containing endrin, employees should change into uncontaminated clothing before leaving the work premises.
- Clothing which has had any possibility of being contaminated with endrin should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of endrin from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the endrin, the person performing the operation should be informed of endrin's hazardous properties.
- Where there is any possibility of exposure of an employee's body to endrin or liquids containing endrin, 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 endrin should be removed immediately and not reworn until the endrin is removed from the clothing.
- Employees should be provided with and required to use dust- and splash-proof safety goggles where there is

any possibility of endrin or liquids containing endrin contacting the eyes.

- Where there is any possibility that employees' eyes may be exposed to endrin, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes contaminated with endrin should be immediately washed or showered with soap or mild detergent and water to remove any endrin.
- Workers subject to skin contact with endrin or liquids containing endrin should wash with soap or mild detergent and water any areas of the body which may have contacted endrin at the end of each work day.
- Eating and smoking should not be permitted in areas where endrin or liquids containing endrin are handled, processed, or stored.
- Employees who handle endrin or liquids containing endrin 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 endrin may occur and control methods which may be effective in each case:

Operation	Controls
Application as an insecticide on cotton fields and vegetable crops, and as a rodenticide against mice and chipmunks in orchards	Personal protective equipment
Formulation for use as an insecticide and rodenticide	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Manufacture of endrin	Local exhaust ventilation; general dilution ventilation; personal protective equipment

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 endrin or liquids containing endrin get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact

lenses should not be worn when working with this chemical.

• Skin Exposure

If endrin or liquids containing endrin get on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If endrin or liquids containing endrin penetrate through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Get medical attention promptly.

• Breathing

If a person breathes in large amounts of endrin, 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 endrin or liquids containing endrin have 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 AND DISPOSAL PROCEDURES

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

- If endrin is spilled, the following steps should be taken:

1. Ventilate area of spill.
2. Collect spilled material in the most convenient and safe manner and deposit in sealed containers for reclamation, or for disposal in a secured sanitary landfill. Liquid containing endrin should be absorbed in vermiculite, dry sand, earth, or a similar material.

- Waste disposal method:

Endrin may be disposed of in sealed containers in a secured sanitary landfill.

ADDITIONAL INFORMATION

To find additional information on endrin, look up endrin in the following documents:

- Medical Surveillance for Chemical Hazards
- Respiratory Protection for Chemical Hazards
- Personal Protection and Sanitation for Chemical Hazards

These documents are available through the NIOSH Division of Technical Services, 4676 Columbia Parkway, Cincinnati, Ohio 45226.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Endrin," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- Christensen, H. E., and Luginbyhl, T. L. (eds.): *NIOSH Toxic Substances List*, 1974 Edition, HEW Publication No. 74-134, 1974.
- Coble, Y., et al.: "Acute Endrin Poisoning," *Journal of the American Medical Association*, 202:153-157, 1967.
- Hayes, W. J., Jr.: *Clinical Handbook on Economic Poisons, Emergency Information for Treating Poisoning*, U.S. Public Health Service Publication No. 476, U.S. Government Printing Office, Washington, D.C., 1963.
- Jager, K. W.: *Aldrin, Dieldrin, Endrin and Telodrin - An Epidemiological and Toxicological Study of Long-Term Occupational Exposure*, Elsevier, Amsterdam, 1970.
- Ottolenghi, A. D., et al.: "Teratogenic Effects of Aldrin, Dieldrin, and Endrin in Hamsters and Mice," *Teratology*, 9:11-16, 1974.
- Shell Chemical Company: *Material Safety Data Sheet - Endrin*.
- 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.
- Spencer, E. Y.: *Guide to the Chemicals Used in Crop Protection* (6th ed.), Publication 1093, Research Branch Agriculture, Canada, 1973.
- Stauden, A. (exec. ed.): *Kirk-Othmer Encyclopedia of Chemical Technology* (2nd ed.), Interscience, New York, 1972.
- Stolman, A. (ed.): *Progress in Chemical Toxicology*, Academic Press, New York, 1965-1969.
- *Survey of Compounds Which Have Been Tested for Carcinogenic Activity*, U.S. Public Health Service Publication No. 149, Original, Supplements 1 and 2, 1961-1967, 1968-1969, and 1970-1971.

RESPIRATORY PROTECTION FOR ENDRIN

Condition	Minimum Respiratory Protection* Required Above 0.1 mg/m ³
Particulate Concentration	
1 mg/m ³ or less	<p>Any chemical cartridge respirator with an organic vapor cartridge(s) and dust and mist filter(s), including pesticide respirators which meet the requirements of this class.</p> <p>Any supplied-air respirator.</p> <p>Any self-contained breathing apparatus.</p>
5 mg/m ³ or less	<p>A chemical cartridge respirator with a full facepiece, organic vapor cartridge(s), and dust and mist filter(s), including pesticide respirators which meet the requirements of this class.</p> <p>A gas mask with a chin-style or a front- or back-mounted organic vapor canister and dust and mist filter, including pesticide respirators which meet the requirements of this class.</p> <p>Any supplied-air respirator with a full facepiece, helmet, or hood.</p> <p>Any self-contained breathing apparatus with a full facepiece.</p>
100 mg/m ³ or less	<p>A powered air-purifying respirator with an organic vapor cartridge and high efficiency particulate filter, including pesticide respirators which meet the requirements of this class.</p> <p>A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.</p>
200 mg/m ³ or less	<p>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.</p>
Greater than 200 mg/m ³ ** or entry and escape from unknown concentrations	<p>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.</p> <p>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.</p>
Fire Fighting	<p>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.</p>
Escape	<p>Any gas mask providing protection against organic vapors and particulates, including pesticide respirators which meet the requirements of this class.</p> <p>Any escape self-contained breathing apparatus.</p>

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

**Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of endrin; however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 200 mg/m³, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.