Occupational Health Guideline for 2,4-D *

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: $Cl_2C_6H_3OCH_2COOH$
- Synonyms: 2,4-Dichlorophenoxyacetic acid
- Appearance and odor: Colorless, odorless solid

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for 2,4-D is 10 milligrams of 2,4-D per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

2,4-D can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may enter the body through the skin.

- **Effects of overexposure**

1. Short-term Exposure: Massive exposure to 2,4-D may cause weakness, stupor, muscle twitching, and convulsions. Contact of the material with the skin may cause a rash. It has caused minor liver and kidney damage in animals.

2. Long-term Exposure: Not 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 2,4-D.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to 2,4-D 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 2,4-D exposure.

—Liver disease: 2,4-D causes liver damage in animals. The importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—Kidney disease: 2,4-D causes kidney damage in animals. The importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Cardiovascular disease: 2,4-D causes ventricular fibrillation in animals. In persons with impaired cardiovascular function, the inhalation of 2,4-D might cause exacerbation of pre-existing disorder.

—Skin disease: 2,4-D can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Convulsive disorder or neuropathy: 2,4-D may cause convulsions in humans. Persons with a history of such disorders may be more susceptible to the effects of this agent. 2,4-D may also produce neuropathy by analogy to effects observed in experimental animals.

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

- **Summary of toxicology**

2,4-D dust causes signs of both hypo- and hyperexcitation of the central nervous system in animals. In several species of animals given massive oral doses, sudden death has been ascribed to ventricular fibrillation. If death is delayed, myotonia, stiffness of the extremities, ataxia, paralysis, and coma are seen; autopsy findings have included minor liver and kidney injury. The myotonia characteristic of intoxication by 2,4-D in animals has not been reported in humans. Possibly the only recognized fatal case of poisoning involved a suicidal person who ingested not less than 6500 mg; the

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person apparently experienced violent convulsions, although they were not actually observed; there were no significant findings at autopsy. A single dose of 3.6 g of 2,4-D administered intravenously to a patient for treatment of disseminated coccidiomycosis caused stupor, hyporeflexia, fibrillary twitching of some muscles, and urinary incontinence; 24 hours after the dose, the patient still complained of profound muscular weakness, which subsided after an additional 24 hours. Contact of the material with the skin may cause dermatitis; skin absorption is slight.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 221
2. Boiling point (760 mm Hg): Decomposes
3. Specific gravity (water = 1): 1.1 (estimated)
4. Vapor density (air = 1 at boiling point of 2,4-D): 7.63
5. Melting point: 140 C (284 F)
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, at 20 C (68 F): 0.07 ppm
8. Evaporation rate (butyl acetate = 1): Not applicable

- **Reactivity**

1. Conditions contributing to instability: None
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride and carbon monoxide) may be released in a fire involving 2,4-D.
4. Special precautions: None

- **Flammability**

1. Flash point: Data not available
2. Autoignition temperature: Data not available
3. Flammable limits in air, % by volume: Data not available
4. Extinguishant: Carbon dioxide, dry chemical, foam, water

- **Warning properties**

Since 2,4-D has a negligible vapor pressure, warning properties are not considered.

Grant states that "2,4-dichlorophenoxyacetic acid (2,4-D) is a herbicide for weed control, often used in the form of its salts or esters. Parenteral administration to dogs has caused sneezing, lacrimation, and rubbing of the eyes, along with gastrointestinal disturbances. In three human beings, absorption of an unspecified ester of dichlorophenoxyacetic acid through the skin caused polyneuritis, but with no disturbance of the eyes or vision." The above do not appear to be local effects on the eye. However, Stolman and Stecher note that this substance can cause irritation of the eyes.

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 2,4-D is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

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 repeated or prolonged skin contact with 2,4-D or liquids containing 2,4-D.
- If employees' clothing may have become contaminated with 2,4-D, employees should change into uncontaminated clothing before leaving the work premises.
- Clothing contaminated with 2,4-D should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of 2,4-D from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the 2,4-D, the person performing the operation should be informed of 2,4-D's hazardous properties.
- Non-impervious clothing which becomes contami-

nated with 2,4-D should be removed promptly and not reworn until the 2,4-D is removed from the clothing.

• Employees should be provided with and required to use dust- and splash-proof safety goggles where 2,4-D or liquids containing 2,4-D may contact the eyes.

SANITATION

• Skin that becomes contaminated with 2,4-D should be promptly washed or showered with soap or mild detergent and water to remove any 2,4-D.

• Eating and smoking should not be permitted in areas where solid 2,4-D is handled, processed, or stored.

• Employees who handle 2,4-D or liquids containing 2,4-D 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 2,4-D may occur and control methods which may be effective in each case:

Operation	Controls
Formulation of herbicides	Process enclosure; local exhaust ventilation; personal protective equipment; washing facilities
Manufacture of 2,4-D	Process enclosure; local exhaust ventilation; personal protective equipment; washing facilities
Application on cereal crops, corn, sorghum, milo, sugar cane, pastures, range land, and lawns for use as an herbicide; use as a plant hormone on agricultural crops	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 2,4-D or liquids containing 2,4-D 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 2,4-D or liquids containing 2,4-D get on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If 2,4-D or liquids containing 2,4-D penetrate through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• **Breathing**

If a person breathes in large amounts of 2,4-D, 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 2,4-D 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 AND DISPOSAL PROCEDURES

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

• If 2,4-D is spilled, the following steps should be taken:

1. Ventilate area of spill.
2. For small quantities, sweep onto paper or other suitable material, place in an appropriate container and burn in a safe place (such as a fume hood). Large quantities may be reclaimed; however, if this is not practical, dispose of by burning in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device, as in below or deposit in a secured sanitary landfill.

• Waste disposal methods:

2,4-D may be disposed of:

1. By making packages of 2,4-D in paper or other flammable material and burning in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.
2. By dissolving 2,4-D in a flammable solvent (such as alcohol) and atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.
3. By disposal in a secured sanitary landfill.

REFERENCES

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* SPECIAL NOTE

The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 15, 1977.

RESPIRATORY PROTECTION FOR 2,4-D

Condition	Minimum Respiratory Protection* Required Above 10 mg/m³
Particulate Concentration	
100 mg/m³ or less	Any chemical cartridge respirator with an organic vapor cartridge(s) and dust filter(s), including pesticide respirators which meet the requirements of this class. Any supplied-air respirator. Any self-contained breathing apparatus.
500 mg/m³ or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s), and dust filter(s), including pesticide respirators which meet the requirements of this class. 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. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 500 mg/m³ 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 organic vapors and particulates, including pesticide respirators which meet the requirements of this class. Any escape self-contained breathing apparatus.

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