

Occupational Health Guideline for Phthalic Anhydride

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: $C_8H_4(CO)_2O$
- Synonyms: PAN
- Appearance and odor: White solid with a characteristic choking odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for phthalic anhydride is 2 parts of phthalic anhydride per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 12 milligrams of phthalic anhydride per cubic meter of air (mg/m^3). The American Conference of Governmental Industrial Hygienists has recommended for phthalic anhydride a Threshold Limit Value of 1 ppm.

HEALTH HAZARD INFORMATION

- **Routes of exposure**
Phthalic anhydride can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.
- **Effects of overexposure**
 1. **Short-term Exposure:** Phthalic anhydride causes irritation of the eyes, nose, throat, and skin. The irritant effects are worse on moist surfaces. If phthalic anhydride is held in contact with the skin as under clothes or shoes, skin burns may occur. Inhalation of the dust or vapors may cause coughing, sneezing, or nosebleeds. Inhalation may cause attacks of asthma in persons who have previously had asthma.

2. **Long-term Exposure:** Repeated or prolonged exposure to phthalic anhydride may cause a skin rash or chronic eye irritation. Repeated exposures may also cause an allergic type of skin rash. It may cause bronchitis and asthma.

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 phthalic anhydride.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to phthalic anhydride 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 asthma, allergies, or known sensitization to phthalic anhydride would be expected to be at increased risk from exposure. Examination of the eyes, respiratory tract, liver, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

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

- **Summary of toxicology**

Phthalic anhydride in the form of vapor, fume, or dust irritates the eyes; it is both an irritant and sensitizer of the skin and respiratory tract, and may produce asthma on repeated exposure. Cats repeatedly exposed to $3700 mg/m^3$ became drowsy, lost appetite and vomited; liver and kidney injury occurred. In workers, air concentrations of $30 mg/m^3$ caused conjunctivitis; at $25 mg/m^3$ there were signs of mucous membrane irritation. Workers exposed to undetermined concentrations of mixed vapors of phthalic acid and phthalic anhydride developed conjunctivitis, bloody nasal discharge, atrophy of the nasal mucosa, hoarseness, cough, occasional bloody

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.

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sputum, and bronchitis. A report of emphysema among workers exposed to phthalic anhydride is questionable. Several cases of bronchial asthma resulted; there was skin sensitization with occasional urticaria and eczematous response. Phthalic anhydride is a direct but delayed irritant of the skin; it is more severely irritating in contact with water, due to the pronounced effects of the phthalic acid which is formed. Prolonged or repeated exposure also may cause dermatitis.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 148
2. Boiling point (760 mm Hg): 284 C (543 F)
3. Specific gravity (water = 1): 1.5
4. Vapor density (air = 1 at boiling point of phthalic anhydride): 5.1
5. Melting point: 131 C (268 F)
6. Vapor pressure at 20 C (68 F): Less than 0.05 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.62 (reacts slowly)
8. Evaporation rate (butyl acetate = 1): Data not available

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as phthalic acid fumes and carbon monoxide) may be released in a fire involving phthalic anhydride.
4. Special precautions: Liquid phthalic anhydride will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: 151 C (304 F) (closed cup)
2. Autoignition temperature: 570 C (1058 F)
3. Flammable limits in air, % by volume (at elevated temperatures): Lower: 1.7; Upper: 10.4
4. Minimum explosive dust concentration: 0.015 g/l
5. Extinguishant: Carbon dioxide, dry chemical, foam

• Warning properties

According to both Patty and the *Hygienic Guide*, exposure to a concentration of 30 mg/m³ causes "definite conjunctival irritation." This concentration is not stated specifically to be the threshold of eye irritation, however.

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

Sampling and analyses may be performed by collection of phthalic anhydride on a cellulose membrane filter, followed by treatment with aqueous ammonia, hydrolysis, and analysis with a high-performance liquid chromatograph. An analytical method for phthalic anhydride 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 solid phthalic anhydride or liquids containing phthalic anhydride.
- If employees' clothing may have become contaminated with solid phthalic anhydride, employees should change into uncontaminated clothing before leaving the work premises.
- Clothing contaminated with phthalic anhydride should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of phthalic anhydride from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the phthalic anhydride, the person performing the operation should be informed of phthalic anhydride's hazardous properties.

- Non-impervious clothing which becomes contaminated with phthalic anhydride should be removed immediately and not reworn until the phthalic anhydride is removed from the clothing.
- Employees should be provided with and required to use dust- and splash-proof safety goggles where solid phthalic anhydride or liquids containing phthalic anhydride may contact the eyes.

SANITATION

- Skin that becomes contaminated with phthalic anhydride should be immediately washed or showered with soap or mild detergent and water to remove any phthalic anhydride.
- Employees who handle solid phthalic anhydride or liquids containing phthalic anhydride 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 phthalic anhydride may occur and control methods which may be effective in each case:

Operation	Controls
Use in manufacture of plasticizers for use in polyvinyl chloride, polyvinyl acetate, copolymer resins, cellulosic plastics, alkyd resins, and nondrying oils or natural resins to enhance properties; manufacture of unsaturated polyester resins for use in structural building parts, swimming pools, automotive parts, and luggage	Process enclosure; general dilution ventilation
Use in synthesis of dyes; use in manufacture of chemicals and chemical intermediates for production of insecticides, insect repellants, chemical reagents, urethane polymers, perfumes, and weed killers	Process enclosure; general dilution ventilation; personal protective equipment

Operation

Use in manufacture of pharmaceuticals and pharmaceutical intermediates; manufacture of metallic and acid salts; manufacture of epoxy resins as curing and hardening agents

Use in manufacture of fire retardants for use as components of polyester resins

Controls

Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment

Process enclosure; general dilution ventilation; local exhaust 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 phthalic anhydride gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If solid phthalic anhydride or liquids containing phthalic anhydride get on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If solid phthalic anhydride or liquids containing phthalic anhydride penetrate through the clothing, remove the clothing immediately 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 phthalic anhydride, 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 phthalic anhydride 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 phthalic anhydride 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, dissolve in a flammable solvent (such as alcohol) and atomize in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. Liquid containing phthalic anhydride should be absorbed in vermiculite, dry sand, earth, or a similar material for disposal in a secured sanitary landfill.

- Waste disposal methods:

Phthalic anhydride may be disposed of:

1. By making packages of phthalic anhydride in paper or other flammable material and burning in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

2. By dissolving phthalic anhydride in a flammable solvent (such as alcohol) and atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

3. Liquid containing phthalic anhydride should be absorbed in vermiculite, dry sand, earth, or a similar material and deposited in a secured sanitary landfill.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Phthalic Anhydride," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.

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- Manufacturing Chemists Association, Inc.: *Chemical Safety Data Sheet SD-61, Phthalic Anhydride*, Washington, D.C., 1956.

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RESPIRATORY PROTECTION FOR PHTHALIC ANHYDRIDE

Condition	Minimum Respiratory Protection* Required Above 2 ppm
Particulate or Vapor Concentration	
100 ppm or 600 mg/m ³ or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
1670 ppm or 10,000 mg/m ³ or less	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.
Greater than 1670 ppm or 10,000 mg/m ³ 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.

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