

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** PHTHALIC ANHYDRIDE ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for PHTHALIC ANHYDRIDE

The basic text of this document contains the draft technical standard approved by the Joint Review Committee of the NIOSH/OSHA Standards Completion Program and the supporting documentation for the substance PHTHALIC ANHYDRIDE.

The SCP draft technical standards are recommendations to the Department of Labor for its consideration in rulemaking and have no legal status until final rules have been promulgated by that agency. This draft standard is provided for your information only.

The References and Sources, Respirator Table Documentation and Use/Exposure and Control Documentation are the working documents used by the various SCP working groups during the development of the draft technical standard and serve as the technical foundation for the standard. The classification for each substance and the regulatory statements were derived following a decision logic established for the various sections of the standard.

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(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of phthalic anhydride not in excess of 2 parts per million (ppm) (12 milligrams per cubic meter (mg/M3)), averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z-1.

(2) "Action level" means one half of the permissible exposure for phthalic anhydride.

(b) Exposure determination and measurement. (1) Each employer who has a place of employment in which phthalic anhydride is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of phthalic anhydride at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of phthalic anhydride.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to phthalic anhydride;

(ii) Any measurements of phthalic anhydride taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to phthalic anhydride; and

(iv) Date of determination, work being performed at the time, location within work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to phthalic anhydride at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b) (3) of this section reveals employee exposure to phthalic anhydride at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to phthalic anhydride at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to phthalic anhydride above the permissible exposure, the employer shall:

(i) Measure the exposure monthly of the employee so exposed; and

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to phthalic anhydride above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

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(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to phthalic anhydride below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph, employee exposure is that which would occur if the employee were not using a respirator.

(c) Methods of measurement. (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (See Appendix B (iv) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

Table 1

Concentration	Required Accuracy
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Above permissible exposure	$\pm 25\%$
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At or below permissible exposure	
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and above the action level	$\pm 35\%$
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At or below the action level	$\pm 50\%$
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(d) Compliance. (1) No employee shall be exposed to phthalic anhydride above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of phthalic anhydride shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not technically feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of phthalic anhydride.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

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- (ii) In work situations in which engineering and work practice controls are technically not feasible; or
 - (iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of phthalic anhydride to at or below the permissible exposure; or
 - (iv) For operations which require entry into tanks or closed vessels; or
 - (v) In emergencies.
- (5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2 RESPIRATORY PROTECTION FOR PHTHALIC ANHYDRIDE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Particulate or Vapor Concentration	
100 ppm or less (600 mg/m ³)	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 less (10,000 mg/m ³)	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 (10,000 mg/m ³) or entry and escape from unknown concen- trations	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.

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e), and (f).

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(e) Fire and safety. (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for phthalic anhydride.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of phthalic anhydride shall be Class II, Group G.

(3) For the purpose of compliance with § 1910.157, phthalic anhydride is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of phthalic anhydride shall be Class II, Group G.

(5) Sources of ignition such as smoking or open flames are prohibited where phthalic anhydride presents a fire or explosion hazard.

(6) Phthalic anhydride shall be stored so as not to come in contact with strong oxidizers.

(f) Personal protective equipment. (1) Employers shall provide and ensure that employees 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. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that employees whose clothing may have become contaminated with solid phthalic anhydride change into uncontaminated clothing before leaving the work premises.

(3) Employers shall ensure that clothing contaminated with phthalic anhydride is placed in closed containers for storage until it can be discarded or until the employer provides 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 employer shall inform the person performing the operation of the hazardous properties of phthalic anhydride.

(4) Employers shall ensure that non-impervious clothing which becomes contaminated with phthalic anhydride be removed promptly and not reworn until the phthalic anhydride is removed from the clothing.

(5) Employers shall provide and ensure that employees use safety goggles (cup-cover type dust and splash safety goggles) which comply with § 1910.133 (a)(2)-(a)(6) where solid phthalic anhydride or liquids containing phthalic anhydride may contact the eyes.

(g) Spills and disposal. In the event that phthalic anhydride is spilled the employer shall immediately provide available ventilation and then clean up the spill.

(h) Sanitation. (1) Employers shall ensure that employees whose skin becomes contaminated with phthalic anhydride promptly wash or shower with soap or mild detergent and water to remove any phthalic anhydride from the skin.

(2) Employers shall ensure that employees who handle solid phthalic anhydride or liquids containing phthalic anhydride wash their hands thoroughly with soap or mild detergent and water before using toilet facilities.

(i) Training and information. (1) Each employer who has a workplace in which phthalic anhydride is present shall keep a copy of this regulation

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with Appendixes A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to phthalic anhydride above the action level or employees who may have skin or eye contact with solid phthalic anhydride or liquids containing phthalic anhydride, or employees who work where a spill of phthalic anhydride may occur, shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for phthalic anhydride (Appendix A of this section);

(ii) Advise affected employees as to the signs and symptoms of exposure to phthalic anhydride.

(iii) Instruct affected employees to advise the employer of the development of signs and symptoms of exposure to phthalic anhydride which are listed in Appendix A of the section;

(iv) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to phthalic anhydride.

(j) Medical surveillance. (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall make available to each employee who is to be exposed to phthalic anhydride or airborne concentrations of phthalic anhydride at or above the action level a medical examination which shall include a medical history and physical examination with emphasis on the eyes, lungs, liver, kidneys and skin.

(3) The employer shall obtain from the physician, as a record of the examination, a written opinion which conforms with paragraph (j)(7) of this section.

(4) The employer shall make available to each employee, exposed to phthalic anhydride in excess of the action level at 12 months from the date of the employee's first exposure, and at every 12 months of exposure in excess of the action level thereafter, a medical examination which must include a medical history and physical examination with emphasis on the eyes, lungs, liver, kidneys and skin.

(5) The employer shall obtain from the physician, as a record of the periodic examination, a written opinion which conforms with paragraph (j)(7) of this section.

(6) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with its Appendixes A, B, and C for phthalic anhydride;

(ii) A description of the employee's duties as they relate to his exposure to phthalic anhydride;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements, which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure; and

(vi) Upon request of the physician, any available information from previous medical examination of the affected employee.

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(7)(i) The physician's written opinion shall be a signed statement by the examining physician specifically stating: (A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to phthalic anhydride or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to phthalic anhydride, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to phthalic anhydride.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(8) No employee shall be exposed to phthalic anhydride or airborne concentrations of phthalic anhydride in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(9) The employer shall provide emergency and follow-up medical examinations and treatment for any employee injured through exposure to phthalic anhydride.

(10) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risks involved by refusing to be examined.

(11) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) Recordkeeping. (1) Exposure determination. (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) This record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) Exposure measurements. (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to phthalic anhydride.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to phthalic anhydride which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

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(3) Mechanical ventilation. (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3) of this section.

(ii) This record shall include:

- (A) Date of measurement;
- (B) Type of measurement taken;
- (C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) Employee training and information. (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

- (A) Date of training;
- (B) Name and social security number of employee trained;
- (C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) Medical surveillance. (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Results of tests required by paragraph (j)(2) and (j)(4) of this section:

(B) Any employee medical complaints relative to exposure to phthalic anhydride;

(C) A copy of information provided to the physician pursuant to paragraph (j)(6)(ii), (iii), (iv), (v), and (vi) of this section.

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) Access to records. (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(1) Employee observation of measurement. (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to phthalic anhydride which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to phthalic anhydride requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

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(3) Without interfering with the measurement, observers shall be entitled to:

- (i) Receive an explanation of the measurement procedure.
- (ii) Visually observe all steps related to the measurement of the airborne concentration of phthalic anhydride that are being performed at the place of exposure; and
- (iii) Record the results obtained.

NOTE: The information contained in the following appendixes is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR PHTHALIC ANHYDRIDE

- I. SUBSTANCE IDENTIFICATION
 - A. Substance: Phthalic anhydride
 - B. Permissible Exposure: 2 parts of phthalic anhydride per million parts of air (ppm) (12 milligrams of phthalic anhydride per cubic meter of air (mg/M3)), averaged over an eight-hour work shift.
 - C. Appearance and Odor: White solid with characteristic choking odor
- II. HEALTH HAZARD DATA
 - A. Ways in which the chemical affects your body: Phthalic anhydride can affect your body if you inhale it or if it comes in contact with your eyes or skin. It may also affect your body if you swallow it.
 - B. 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.

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3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by exposure to phthalic anhydride.

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If phthalic anhydride gets into your eyes, wash your 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.
- B. Skin Exposure: If solid phthalic anhydride or liquids containing phthalic anhydride get on your skin, promptly wash your skin using soap or mild detergent and water. If solid phthalic anhydride or liquids containing phthalic anhydride penetrates your clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. If irritation is present after washing, get medical attention.
- C. Breathing: If you or any other 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.
- D. Swallowing: When phthalic anhydride has been swallowed, 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.
- E. Rescue: Move 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 yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

- A. Respirators: Respirators are not the best way to control exposure to phthalic anhydride. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where there use is required. If you can smell phthalic anhydride while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

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- B. Protective Clothing: You must wear impervious clothing, gloves, face shield or other appropriate protective clothing to prevent repeated or prolonged skin contact with solid phthalic anhydride or liquids containing phthalic anhydride. Replace or repair impervious clothing that has developed leaks.
- C. Eye Protection: You must wear dust-resistant safety goggles where solid phthalic anhydride may contact your eyes. You must wear splash-proof safety goggles where liquids containing phthalic anhydride may contact your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. Phthalic anhydride is a combustible solid at normal room temperatures, and its vapors or dust can form explosive mixtures with air at elevated temperatures.
- B. Phthalic anhydride must be stored in tightly closed containers in a cool, well-ventilated area away from heat and strong oxidizers.
- C. Sources of ignition such as smoking and open flames are prohibited wherever phthalic anhydride is handled, used or stored in a manner that could create a potential fire or explosion hazard.
- D. If your work clothing may have become contaminated with solid phthalic anhydride, you must change into uncontaminated clothing before leaving the work premises.
- E. You must promptly remove any non-impervious clothing that becomes contaminated with phthalic anhydride and this clothing must not be reworn until the phthalic anhydride is removed from the clothing.
- F. If your skin becomes contaminated with phthalic anhydride, you must promptly wash or shower with soap or mild detergent and water to remove the phthalic anhydride from your skin.
- G. If you handle solid phthalic anhydride or liquids containing phthalic anhydride, you must wash your hands thoroughly with soap or mild detergent and water before using toilet facilities.
- H. Fire extinguishers and eye flushing facilities, where provided, must be readily available and you should know where they are and how to operate them.
- I. Ask your supervisor where phthalic anhydride is used in your work area and for any additional plant safety and health rules.

VI. ACCESS TO INFORMATION

- A. Each year your employer is required to inform you of the information contained in this Substance Safety Data Sheet for phthalic anhydride. In addition, your employer must instruct you in the safe use of phthalic anhydride, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to phthalic anhydride. You or your representative have the right to observe employee exposure measurements and to record the results obtained. If your employer determines that you are being overexposed, he is required to inform you

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of the exposure and of the actions which are being taken to reduce your exposure.

- C. Your employer is required to keep records of exposure determinations, exposure measurements, and medical surveillance. Your employer is required to make records of exposure determinations and your exposure measurements available to you or your representative upon your request. Your employer is required to release your medical records to your physician upon your written request.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
FOR PHTHALIC ANHYDRIDE

- I. PHYSICAL AND CHEMICAL DATA
- A. Substance Identification
1. Synonyms: PAN
 2. Formula: $C_6H_4(CO_2)_O$
 3. Molecular weight: 148
- B. Physical Data
1. Boiling point (760 mm Hg): 284 C (543 F)
 2. Specific gravity (water = 1): 1.5
 3. Vapor density (air = 1 at boiling point of phthalic anhydride): 5.1
 4. Melting point: 131 C (268 F)
 5. Vapor pressure at 20 C (68 F): Less than 0.05 mm Hg
 6. Solubility in water, % by weight at 20 C (68 F): 0.62 (reacts slowly)
 7. Evaporation rate (butyl acetate = 1): Data not available
 8. Appearance and odor: White solid with a characteristic choking odor.
- II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA
- A. Fire
1. Flash point: 151 C (304 F) (closed cup)
 2. Autoignition temperature: 570 C (1058 F)
 3. Minimum dust ignition temperature: 605 C (1121 F)
 4. Flammable limits in air, % by volume (at elevated temperatures): Lower: 1.7; Upper: 10.4
 5. Minimum explosive dust concentration: 0.015 g/l
 6. Extinguishing media: Carbon dioxide, dry chemical, foam
 7. Special fire-fighting procedures: Do not use a solid stream of water since a stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
 8. Unusual fire and explosion hazards: Phthalic anhydride is a combustible solid. Its vapors or dusts can form

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explosive mixtures with air. All ignition sources must be controlled where phthalic anhydride is used, handled or stored in a manner that could create a potential fire or explosion hazard.

9. For purposes of complying with the requirements of 29 CFR 1910.106, liquid phthalic anhydride should be considered as a Class IIIB combustible liquid. For example, 4300 ppm, approximately one-fourth of the lower flammable limit, is one situation in which liquid phthalic anhydride is considered to be a potential fire and explosion hazard.
10. For purposes of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for phthalic anhydride shall be Class II, Group G.

B. 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.

III. SPILL AND DISPOSAL PROCEDURES

A. 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 similar material for disposal in a secured sanitary landfill.

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

C. 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.

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

IV. MONITORING AND MEASUREMENT PROCEDURES

- A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the average 8-hour exposure may be determined from a single eight-hour sample or two (2) 4-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). Sampling and analysis may be performed by collection of the particulates and vapors using a high efficiency membrane filter followed by an adsorption tube with subsequent chemical analysis of both the filter and adsorption tube. Detector tubes certified by NIOSH under 42 CFR part 84 or other direct-reading devices calibrated to measure phthalic anhydride may be used. The method of measurement must determine the concentration of phthalic anhydride to plus or minus 35%.
- B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring and measurements under this section should be essentially the same as described under paragraph IV. A. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association. The method of measurement must determine the concentration of phthalic anhydride to plus or minus 25%.
- C. METHODS: Methods meeting these accuracy requirements are available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161 under the title "NIOSH Analytical Methods for Set M" (Order number XXXXXXXXXX).
- D. QUALIFIED PERSONS: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

- A. Store phthalic anhydride in tightly closed containers in a cool, well ventilated area.
- B. Employers should advise employees of all areas and operations where exposure to phthalic anhydride could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to phthalic anhydride is likely to occur are: during its production and its use in the manufacture of plasticizers, alkyd resins, unsaturated polyester resins, dyes, pigments, terephthalic acid, pharmaceuticals and pharmaceutical intermediates, benzoic acid, metallic and acid salts of phthalic anhydride, epoxy resins, and fire retardants.

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APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

Phthalic anhydride in the form of the vapor, fume, or dust is an irritant of 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/M3 became drowsy, lost appetite and vomited; liver and kidney injury occurred. In workers, air concentrations of 30 mg/M3 caused conjunctivitis; at 25 mg/M3 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 sputum, and bronchitis. A report of emphysema among workers exposed to phthalate 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 after contact with water, due to the pronounced effects of the phthalic acid which is formed. Prolonged or repeated exposure also may cause dermatitis.

III. SIGNS AND SYMPTOMS

Conjunctivitis; nasal ulceration and bleeding; upper respiratory tract irritation; bronchial asthma; dermatitis from prolonged or repeated exposure; by analogy to effects caused in animals it may cause liver and kidney damage.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Promptly flush eyes and skin with water. If swallowed and the person is conscious, immediately administer water orally and induce vomiting. Give artificial resuscitation and administer oxygen if indicated. Consideration should be given to hospitalization and observation for the possible delayed onset of pulmonary edema. Recovery is usually complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

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Phthalic anhydride is irritating to the eyes, upper respiratory tract and skin and may cause sensitization dermatitis or bronchial asthma. It is important that the physician become familiar with plant operating conditions in which exposure to phthalic anhydride occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. PREPLACEMENT

The following medical procedures must be made available to each employee who is exposed to phthalic anhydride:

1. A complete history and physical examination -- The purpose is to detect preexisting 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.

C. PERIODIC EXAMINATIONS

The above medical examinations are to be repeated on an annual basis.

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Phthalic Anhydride," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 212.
2. Hygienic Guide Series: "Phthalic Anhydride," American Industrial Hygiene Association Journal, 28:395-398, 1967.
3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1822-1823.
4. Manufacturing Chemists Association, Inc.: Chemical Safety Data Sheet SD-61, Phthalic Anhydride (Commercial), Washington, D.C., 1956, pp. 5-6, 13-15.

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REFERENCES AND SOURCES
PHTHALIC ANHYDRIDE
1910.93

- (e) Fire and Safety
(1) Electrical - K. N. Palmer's "Dust Explosions and Fires," reports that 0.015 g/l phthalic anhydride dust is explosive.
- (f) Personal Protective Equipment, and, (h) Sanitation
Eye: "Phthalic Anhydride," Manufacturing Chemists' Association; "Phthalic Anhydride," Hazard Process Index; Grant, "Toxicology of the Eye"
Skin: "Phthalic Anhydride," Manufacturing Chemists' Association; "Phthalic Anhydride," AIHA Hygienic Guide Series; "Phthalic Anhydride," Hazard Process Index; "Phthalic Anhydride," Industrial Bio-Test Laboratories
Ingestion: "Phthalic Anhydride," Industrial Bio-Test Laboratories; "Phthalic Anhydride," Manufacturing Chemists' Association; Patty, "Industrial Hygiene and Toxicology;" Interscience "Methods of Biochemical Analysis;" "Phthalic Anhydride," Hygienic Guide Series

COMMENTS

Eye - Classification: 2 and 6

Output statement numbers: 10, 12

Exceptions: 10 and 12 combined

The Manufacturing Chemists' Association reports that phthalic anhydride "solid and dust may produce marked irritation of the conjunctiva and cornea if not promptly removed by prolonged irrigation." The Hazard Process Index adds that corneal burns may result from contact. Grant states that the dust, vapor or fumes are capable of "causing persistent conjunctivitis in some cases, but no permanent injury."

Classifications of 2 and 6 are concluded to be appropriate.

Skin - Classification: 2

Output statement numbers: 2, 5b, 7a, 17g, 17i, 20a

Exceptions: See below

The Manufacturing Chemists' Association comments that phthalic anhydride, while of low toxicity, may act as a local irritant to body tissues . . . "but it does not always immediately cause a burning sensation upon contact with the skin, particularly if the skin is dry." They note, "if the solid form is permitted to remain in contact with moist tissues, superficial burns may result . . . (due to rapid hydrolysis to phthalic acid) . . . and if it is held in contact with skin under clothing such as shoes or gloves, burns of an increase severity may result." They add, "in case it is not removed by washing, the skin will become reddened and occasionally vesicles may be formed followed by desquamation of the skin if the exposure is prolonged or severe." The Hygienic Guide Series note phthalic anhydride "produces a contact dermatitis with redness and burning and with continued exposure may cause dryness with a chapped appearance or urticaria. Sensitization may also occur. According to the Hazard Process

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Index, a brown staining of the skin may result from contact. The Industrial Bio-Test Labs list a rabbit primary skin irritation score of 1.00/8.00. They also give a rabbit acute dermal LD of greater than 10,000 mg/kg and note, "no signs of intoxication were observed, but mild erythema and edema were noted in terms of dermal irritation."

Phthalic anhydride has a melting point of 268 degrees F, a flash point of 304 degrees F, a vapor pressure of less than 0.05 mm Hg at 20 degrees C, and a 0.62% solubility in water.

The data clearly indicate that the substance is not immediately harmful when contacted but should not be contacted repeatedly or for a prolonged period of time. A classification of 2 is, therefore, concluded to be appropriate. The Hygienic Guide notes that "workers handling phthalic anhydride should have clean clothing, rubber gloves and head covering every day." Statement 20a is used only to prevent the possibility of sensitization of sensitive body areas.

Ingestion - Classification: 0

Output statement numbers: None

Exceptions: None

The Manufacturing Chemists' Association states that phthalic anhydride is not acutely toxic and that systemic effects have not been recognized. They add, "phthalic anhydride has been fed to dogs in amounts of 1 - 6 grams with nothing except local action on the intestinal tract." Interscience reports that 1 - 4% phthalic anhydride in rat's diet for one year had no effect. Patty lists an approximate rat LD50 of greater than 3200 mg/kg (mono K salts) and notes that some lowering of blood pressure and minor signs of central nervous system excitation were observed. The Hygienic Guide Series reports oral rat LD50 values of 2500 - 5000 mg/kg and 800 - 1600 mg/kg were given by Malter and Zielhaus and Eastman Kodak Co. They add, "at higher values, death was attributed to tubular necrosis of the kidney." The Industrial Bio-Test Laboratories give an oral rat LD of 4020 mg/kg; the signs of intoxication included "hypothermia, lethargy, ruffled fur, diuresis and diarrhea." They add, "in rats who died, inflammation of the gastrointestinal tract and hyperemia of the liver and lungs were noted."

The chronic feeding data from Interscience and the moderate acute oral toxicity of the substance lead to the conclusion that ingestion would not present a significant hazard in the industrial environment.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

- National Fire Protection Association, "Fire Protection Guide on Hazardous Materials," 5th edition, 1973 (NFPA)
- K. N. Palmer, "Dust Explosions and Fires" (Palmer)
- Manufacturing Chemists' Association, Chemical Safety Data Sheet SD-61, 1956 (MCA)
- Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 15,

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p. 444 (K-O)

Sources of data items used:

- I. A. 1. Synonyms: K-O
2. Formula: NFPA-325M; MCA
3. Molecular weight: MCA
- B. 1. Boiling point: NFPA-325M; MCA
2. Specific gravity: NFPA-325M; MCA
3. Vapor density: Calculated
4. Melting point: NFPA-49; MCA
5. Vapor pressure: K-O
6. Solubility in water: K-O
7. Evaporation rate: Not available
8. Appearance and odor: NFPA-49; AIHA Hygienic Guides
- II. A. 1. Flash point: MCA; K-O
2. Autoignition temperature: NFPA-325M
2a. Ignition temperature: Palmer
3. Flammable limits: MCA
3a. Explosive dust concentration: Palmer
4. Extinguishing media: NFPA-49, MCA
5. Special fire fighting procedures: NFPA-49; NFPA-325M
6. Unusual fire and explosion hazards: NFPA-49; ADL
- B. 1. Conditions contributing to instability: ADL
2. Incompatibilities: ADL
3. Hazardous decomposition products: ADL
4. Special precautions: ADL
- III. A. Steps if released or spilled: ADL
C. Waste disposal method: MCA
- V. Miscellaneous precautions: NFPA-49; MCA

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

- International Labour Office, "Encyclopedia of Occupational Health and Safety, 1972 (ILO)
 - Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience Publishers, 2nd edition, 1972 (ILO)
 - "Phthalic Anhydride," Allied Chemical Corporation, Plastics Division, 1961 (Allied Chemical)
 - "Phthalic Anhydride," Hazard Process Index, Hazard Entry # 161, NIOSH HSM-99-73-62 (HPI)
 - "Phthalic Anhydride," Hygienic Guide Series, American Industrial Hygiene Association, July - August 1967 (Hygienic Guide)
 - "Phthalic Anhydride," Technical Bulletin T-16-235, Koppers Company, Inc. (Koppers)
 - "Phthalic Anhydride," Chemical Safety Data Sheet SD-61, Manufacturing Chemists' Association, 1956 (CSDS)
 - Stanford Research Institute, "Chemical Economics Handbook" (SRI)
- References for Specific Use/Exposure

- 1. K-O, SRI
- 2. HPI, ILO, K-O
- 3. HPI, K-O, Koppers
- 4. ILO, K-O
- 5. K-O, Koppers, SRI
- 6. ILO, K-O, SRI

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7. Koppers, SRI
8. Allied Chemical, K-O, Koppers
9. Allied Chemical
10. SRI
11. CSDS

References for Specific Control Methods

CSDS and Hygienic Guide were the references used in all of the the Specific Control Methods.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Phthalic anhydride

D. O. L. STANDARD: 2 ppm or 12 mg/M3

Eye Irritation Level: According to both Patty and the Hygienic Guides, exposure to a concentration of 30 mg/M3 causes "definite conjunctival irritation." This concentration is not specifically stated to be the threshold of eye irritation, however.

IDLH: 10,000 mg/M3

Basis for IDLH Value: Since there are no acute inhalation toxicity data upon which to base an IDLH concentration for phthalic anhydride, the chosen IDLH (10,000 mg/M3) is based upon repeated exposure data reported in the Hygienic Guides. "Exposure of rats and rabbits to 10,000 mg/M3 for four hours a day for several days produced 25% fatality."

Other Toxicological Information: Patty reports that phthalic anhydride is a potent skin, eye, and upper respiratory (tract) irritant and can cause skin and possibly pulmonary sensitization. In spite of this, enormous quantities are handled yearly with relatively little difficulty. Baader and Menschick have published studies on exposed people in factories making phthalic acid and anhydride. In both of these studies, the clinical findings were principally conjunctivitis, bloody nasal discharge, atrophy of the nasal mucosa, hoarseness, cough, occasional bloody sputum, bronchitis, and emphysema. Four cases of bronchia (sic) asthma were attributed by Menschick to this exposure. . . . Some lowering of blood pressure and minor signs of central nervous system excitation were reported. Skin sensitization and eczematous responses were noted and, in some instances, urticaria."

The AIHA Hygienic Guides do not give an IDLH concentration but state that based "on the responses of small animals it (the IDLH) will be at least several hundred times the TLV." The Hygienic Guides further state that "exposure of rats and rabbits to 10,000 mg/M3 for four hours a day for several days produced 25% fatality. Cats exposed to 3,700 mg/M3 for six hours a day for seven days became drowsy with loss of appetite and vomited; liver and kidney injury was observed.

According to MCA, phthalic anhydride is not acutely toxic.

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	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor or mist during use in the manufacture of plasticizers (dialkyl phthalates: dioctyl phthalate - most common, dibutyl phthalate, octyl decyl phthalate, diethyl phthalate). These plasticizers are used in polyvinyl chloride and copolymer resins, polyvinyl acetate and cellulosic plastics	A	Process enclosure; general dilution ventilation
2.	Inhalation of vapor or mist during use in the manufacture of alkyd resins (phthalic anhydride plus a polyhydric alcohol with a modifier such as drying oils, nondrying oils or natural resins to enhance properties)	A	Process enclosure; general dilution ventilation
3.	Inhalation of vapor or mist during use in the manufacture of unsaturated polyester resins (phthalic anhydride plus a glycol to form an ester; this ester is reacted with a monomer - styrene, methyl methacrylate - to produce the resin). These resins have many uses - structural building parts, swimming pools, automotive parts, luggage.	A	Process enclosure; general dilution ventilation
4.	Inhalation of vapor, mist or dust and skin contact with mist, dust or crystals during use in the synthesis of dyes and pigments (alizarine, xanthene, anthraquinone, rhodamine, phthalocyanine)	A,B,	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment (goggles, gloves)

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| 5. | Inhalation of vapor, mist or dust and skin contact with mist, dust, crystal or liquid during use in the manufacture of chemicals and chemical intermediates (highly reactive and capable of undergoing the typical reactions of dicarboxylic acids as well as of benzene). These chemicals are used in the manufacture of insecticides, insect repellants, chemical reagents, urethane polymers, perfumes, weed killers. Two important chemicals which can be made with phthalic anhydride are benzoic acid and terephthalic acid but at this time they are not produced this way in the U. S. | A,B | Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment (goggles, gloves) |
| 6. | Inhalation of vapor, mist or dust and skin contact with mist, dust, crystals or liquid during manufacture and processing of phthalic anhydride (catalytic oxidation of naphthalene or o-xylene and purified by vapor distillation). | A,B | Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment (goggles, gloves) |
| 7. | Inhalation of vapor, mist or dust and skin contact with mist, dust or crystals during use in the manufacture of pharmaceuticals and pharmaceutical intermediates (phenolphthalein, mercurochrome, sulfathalidine, phthalysulfacetamide, phthalysulfathiazole) | A,B | Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment (goggles, gloves) |
| 8. | Inhalation of vapor, mist or dust and skin contact with mist, dust or crystals during the manufacture of metallic and acid salts of phthalic anhydride (sodium salts tanning, lead salts - | A,B | Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment (goggles, gloves) |

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stabilizers in polyvinyl chloride wire insulation, others include uses as emulsifying agents, mildew inhibitors in paint, catalysts and paint constituents)

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| 9. | Inhalation of vapor, mist or dust and skin contact with mist, dust or crystals during use in the production of epoxy resins (curing agent or hardener) | A,B | Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment (goggles, gloves) |
| 10. | Inhalation of vapor, mist or dust and skin contact with mist, dust or crystals during use in the manufacture of fire retardants which are used as components of polyester resins (tetrachlorophthalic anhydride, tetrabromophthalic anhydride) | A,B | Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment (goggles, gloves) |
| 11. | Inhalation of vapor, mist or dust and skin contact with mist, dust or solid during cleaning and maintenance of storage vessels and during clean up of accidental spills | A,B | General dilution ventilation; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles and aprons) |

- A -- Inhalation
- B -- Skin and eye contact resulting in localized irritation
- C -- Ingestion
- D -- Skin contact resulting in absorption and subsequent systemic poisoning