

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** DDT ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

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 DDT.

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.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of DDT not in excess of 1 milligram 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 DDT averaged over an eight-hour work shift.

(3) DDT means the compound 2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane.

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

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

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

(ii) Any measurements of DDT taken;

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

(iv) Date of initial determination, work being performed at the time, location within work site, and employees considered.

(3) If the employer determines that any employee may be exposed to DDT above the permissible exposure, 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 DDT above the action level, the employer shall:

(i) Identify all employees who may be exposed above the permissible level; and

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

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

(6) If an employee exposure measurement reveals that an employee is exposed to DDT 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 DDT above the permissible exposure. The employee shall also be notified of the results of the exposure measurements and of the corrective action being taken to reduce the exposure to below the permissible exposure.

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

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

(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
---------------	-------------------

Above permissible exposure	$\pm 25\%$
----------------------------	------------

At or below permissible exposure and above the action level	$\pm 35\%$
--	------------

At or below the action level	$\pm 50\%$
------------------------------	------------

(d) Compliance. (1) No employee shall be exposed to DDT above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of DDT 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 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 local exhaust is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity or static pressure, 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 DDT.

(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

(ii) In work situations in which engineering and work practice controls are not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of DDT to at or below the permissible exposure; or

(iv) For operations which require entry into tanks or closed vessels; or

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

(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 DDT

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Particulate Concentration	
10 mg/M3 or less	Any chemical cartridge respirator with an organic vapor cartridge and dust and mist filter(s).** Any supplied-air respirator. Any self-contained breathing apparatus.
50 mg/M3 or less	Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s) and dust and mist filter(s).** A gas mask with a chin-style or front- or back-mounted organic vapor canister and dust and mist filter.** Any supplied-air respirator with a full facepiece, helmet or hood. Any self-contained breathing apparatus with a full facepiece.
500 mg/M3 or less	A powered chemical cartridge respirator with an organic vapor cartridge and a high efficiency filter.** 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.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

** Including pesticide respirators which meet the requirements of this class.

(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).

(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 DDT.

(2) DDT 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 appropriate protective clothing and equipment necessary to prevent repeated or prolonged skin contact with DDT or liquids containing DDT. 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 DDT or liquids containing DDT change into uncontaminated clothing before leaving the work premises.

(3) Employers shall ensure that clothing contaminated with DDT is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of DDT from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the DDT, the employer shall inform the person performing the operation of the hazardous properties of DDT.

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

(5) Employers shall provide and ensure that employees use safety goggles which comply with § 1910.133(a)(2)-(a)(6) where DDT or liquids containing DDT may contact the eyes.

(g) Spills and disposal. In the event that DDT 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 DDT promptly wash or shower with soap or mild detergent and water to remove any DDT from the skin.

(2) Employers shall ensure that employees do not eat or smoke in areas where DDT or liquids containing DDT are handled, processed or stored.

(3) Employers shall ensure that employees who handle DDT or liquids containing DDT wash their hands thoroughly with soap or mild detergent and water before eating or smoking.

(i) Training and information. (1) Each employer who has a workplace in which DDT is present shall keep a copy of this regulation 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 DDT above the action level without regard to the use of respirators, or employees who may have repeated or prolonged skin contact or who may have eye contact with DDT or

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

liquids containing DDT, or employees who work where a spill of DDT may occur, shall annually:

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

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

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

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

(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) Preplacement medical examination. The employer shall make available to each employee who is exposed, or will be exposed, to airborne concentrations of DDT above the action level, without regard to the use of respirators, or employees who may have repeated or prolonged skin contact or who may have eye contact with DDT or liquids containing DDT, a preplacement medical examination which must include a medical history and physical examination with emphasis on the nervous system, kidneys, liver and skin.

(3) Periodic medical examination. The employer shall make available to each employee exposed to airborne concentrations of DDT above the action level, without regard to the use of respirators, or employees who may have repeated or prolonged skin contact or who may have eye contact with DDT or liquids containing DDT, twelve months from the date of the employee's first exposure, and every twelve months thereafter, a periodic medical examination which must include a medical history and physical examination with emphasis on the nervous system, kidneys, liver and skin.

(4) Interim medical examination. The employer shall provide an interim medical examination for the employee if the employee informs the employer of any of the signs or symptoms of exposure to DDT which are listed in Appendix A which the employee suspects are caused by exposure to DDT.

(5) Informing the physician. The employer shall provide to the physician performing any medical examination required by this section the following information:

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

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

(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 level; and

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

(6) Where a medical examination is required by paragraphs (j)(2), (j)(3), or (j)(5) of this section, following such examination the employer shall

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

obtain from the examining physician a written opinion which conforms with paragraph (j)(8) of this section.

(7) Physician's written opinion. (i) The physician's written opinion by the examining physician shall specifically state:

(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 DDT;

(B) Any recommended limitations upon the employee's exposure to DDT, 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 the employee's employment.

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

(8) No employee shall be exposed to DDT in such a way as would put the employee at increased risk of material impairment of his health from such exposure. The employer shall base this decision on any information available including the physician's written opinion.

(9) No medical procedure which would be performed pursuant to paragraphs (j)(2) or (j)(3) of this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(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 risk involved by refusal to be examined.

(11) The employer shall provide emergency medical treatment for any employee injured through exposure to DDT.

(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 DDT.

(ii) This record shall include:

(A) The date of measurement;

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

(C) Sampling and analytical method used and evidence of their accuracy;

(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.

(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:

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

- (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) The name and social security number of the employee;
- (B) Results of tests required by paragraph (j)(2) and (j)(3) of this section and results of any tests conducted pursuant to paragraphs (j)(4) of this section;
- (C) Any employee medical complaints relative to exposure to DDT;
- (D) A copy of information provided to the physician pursuant to paragraph (j)(5)(ii), (iii), (iv), (v), and (vi) of this section.
- (E) Physician's written opinion; and
- (F) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of and for thirty years after termination 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) Each employee or former employee shall have access to the exposure determination and exposure measurement records required to be maintained by this section which indicate his own exposure to DDT.

(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. (i) The employer shall give each employee or his representative an opportunity to observe any measurement of his exposure to DDT which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to DDT 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.

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

- (i) Receive an explanation of the measurement procedure.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

- (ii) Visually observe all steps related to the measurement of the airborne concentration of DDT that are being performed at the place of exposure; and
- (iii) Record the results obtained.

NOTE: The information contained in the following appendix for DDT is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligation. To the extent the information supplements this regulation for DDT, it is advisory in nature.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR DDT

I. SUBSTANCE IDENTIFICATION

- A. Substance: DDT; 2,2-bis(p-chloro-phenyl)-1,1,1-trichloroethane
- B. Permissible Exposure: 1 milligram of DDT per cubic meter of air (mg/M3) averaged over an eight-hour work shift.
- C. Appearance and Odor: Colorless solid with a weak chemical odor

II. HEALTH HAZARD DATA

- A. Ways in which the chemical affects your body: DDT can affect your body if you inhale it or if it comes in contact with your eyes or skin or if you swallow it. When contained in a liquid, it may enter your body through your skin.
- B. Effects of Overexposure:
 - 1. Swallowing DDT has caused tingling, numbness, tremors, anxiety, confusion, headache, sore throat, fatigue, convulsions, coma and death. Swallowing very large doses may cause vomiting. Heavy exposure to DDT dust may irritate the eyes and skin. DDT can also be absorbed through the lungs and skin. Animal exposures have caused liver and kidney damage, liver cancer and other cancers.
 - 2. Reporting Symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by exposure to DDT.

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If DDT or liquids containing DDT get into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention immediately. Contact lenses should not be worn when working with this chemical.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

- B. Skin Exposure: If DDT or liquids containing DDT get on your skin, promptly wash the contaminated skin using soap or mild detergent and water. If DDT or liquids containing DDT penetrate through your clothing, promptly remove the clothing and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.
- C. Breathing: If you or any other person breathes in large amounts of DDT 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 DDT or liquids containing DDT 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.
- 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 emergency rescue equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

- A. Respirators: Respirators are not the best way to control exposure to DDT. 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 their use is required. If you can smell DDT 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.
- B. Protective Clothing: You must wear appropriate protective clothing and equipment to prevent repeated or prolonged skin contact with DDT or liquids containing DDT. Replace or repair impervious clothing that has developed leaks.
- C. Eye Protection: You must wear splash-proof safety goggles where liquids containing DDT may contact your eyes. You must wear dust-resistant safety goggles where DDT may contact your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. DDT must be stored in tightly closed containers in a cool, well ventilated area away from strong oxidizers.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

- B. If your work clothing may have become contaminated with DDT or liquids containing DDT, you must change into uncontaminated clothing before leaving the work premises.
- C. You must promptly remove any non-impervious clothing that becomes contaminated with DDT and this clothing must not be reworn until the DDT is removed from the clothing.
- D. If your skin becomes contaminated with DDT, you must promptly wash or shower with soap or mild detergent and water to remove the DDT from your skin.
- E. You must not eat or smoke in areas where DDT or liquids containing DDT are handled, processed or stored.
- F. If you handle DDT or liquids containing DDT, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.
- G. Ask your supervisor where DDT is used in your work area and for any additional 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 DDT. In addition, your employer must instruct you in the safe use of DDT, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to DDT. 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 of the exposure and the actions which are being taken to reduce your exposure.
- C. Your employer is required to keep records of your exposure and medical examinations. Your employer is required to keep exposure data for at least one year and to keep medical data during your employment, and for a period of thirty years following your termination of employment. Your employer is required to make the exposure data available to you upon your request. Your employer is also required to release your medical records to your physician upon your written request.
- D. Your employer must give you a copy of the physicians written opinion for any physical examination required by this standard.

NOTE: The information contained in the following appendix for DDT is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligation. To the extent the information supplements this regulation for DDT, it is advisory in nature.

APPENDIX B

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

SUBSTANCE TECHNICAL GUIDELINES
FOR DDT

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: P,p'-DDT; 2,2-bis(p-chlorophenyl)-1,1,1-tri-chloroethane; dichlorodiphenyltrichloroethane
2. Formula: $C_{14}H_9Cl_5$
3. Molecular weight: 354.5

B. Physical Data

1. Boiling point (760 mm Hg): Decomposes
2. Specific gravity (water = 1): 1.6
3. Vapor density (air = 1 at boiling point of DDT): Not applicable
4. Melting point: 89 C (192 F) (technical grade); 109 C (228 F) (pure grade)
5. Vapor pressure at 20 C (68 F): 0.00000017 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): 0.00001
7. Evaporation rate (butyl acetate = 1): Not applicable
8. Appearance and odor: Colorless solid with a weak chemical odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Not combustible

B. Reactivity

1. Conditions contributing to instability: Temperatures above 100 C (212 F) may cause slow decomposition.
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, calcium monoxide and carbon monoxide) may be released when DDT decomposes.
4. Special precautions: None.

III. SPILL AND DISPOSAL PROCEDURES

A. If DDT 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 sealed containers in a secured sanitary landfill. Liquid containing DDT should be absorbed in vermiculite, dry sand, earth or a similar material.

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

C. Waste disposal methods: DDT may be disposed of in sealed containers 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 eight-hour exposure may be determined from a single eight-hour sample or two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

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 analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR part 84, portable direct-reading instruments, dosimeters, or by collection of particulates using a high efficiency membrane filter with subsequent chemical analysis. The method of measurement must determine the concentration of DDT 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 DDT 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 S" (Order number XXXXXXXXXXXX).
- 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 DDT in tightly closed containers in a cool, well ventilated area.
- B. Employers should advise employees of all areas and operations where their exposure to DDT could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to DDT is likely to occur are: During its production and its use as an insecticide.

NOTE: The information contained in the following appendix for DDT is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligations. To the extent the information supplements this regulation for DDT, it is advisory in nature.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption; ingestion.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

II. TOXICOLOGY

DDT (2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane), absorbed as dust from ingestion or inhalation, or in solution through the skin, affects the nervous system at high doses and causes paresthesia, tremor, and convulsions. The hepatocarcinogenicity of DDT by the oral route has been demonstrated in several strains of mice. In female rats treated orally with 100 mg/kg DDT had a marginally positive effect in the dominant lethal test of mutagenicity. Ingestion by humans of 10 mg/kg is sufficient to cause effects in some, and convulsions have frequently occurred after ingestion of 16 mg/kg; 285 mg/kg has been taken without fatal results. The onset of effects, usually occurring 2 or 3 hours after ingestion, is characterized by paresthesia of the tongue, lips, and face; the subject soon suffers from tremor, a sense of apprehension, dizziness, confusion, malaise, headache, and fatigue; in severe intoxication, convulsions may occur and there may be paresis of the hands. Ingestion of very large doses induces vomiting. Recovery is well advanced or complete in 24 hours except in the most serious cases; 3 persons who each ingested an estimated 20 g of DDT showed a residual weakness of the hands after 5 weeks. Chronic poisoning in humans has not been described. Large oral doses of DDT in rats caused focal and centrilobular necrosis of the liver and mild degeneration of kidney tubular epithelium; however, in clinical evaluation and laboratory studies of 31 workers exposed to equivalent oral intakes of 3.6 to 18 mg daily (based on storage of DDT in fat and excretion of metabolites in urine) for an average of 21 years, there was no evidence of hepatotoxicity; an observed increase in activity of hepatic microsomal enzymes was not accompanied by clinical evidence of detriment to general health. Continued absorption of DDT by humans results in storage of DDT and metabolites, including DDE (2,2-bis(p-chlorophenyl)-1,1-dichloroethylene) in fat. In a study of 20 workers exposed to DDT for 11 to 19 years and with a calculated daily intake of 18 mg per person, the sum of isomers and metabolites of DDT in the fat was 38 to 647 ppm (compared to an average of 8 ppm for the general population); while DDE was the major excretory product in the general population, DDA (2,2-bis(p-chlorophenyl)acetic acid) was the major excretory product in DDT-exposed workers. Heavy exposure to DDT dust may result in eye and skin irritation.

III. SIGNS AND SYMPTOMS

Paresthesia of the tongue, lips, and face; tremor; sense of apprehension, dizziness, confusion, malaise, headache, fatigue; convulsions; paresis of hands; vomiting; eye and skin irritation.

IV. SPECIAL TESTS

Determination of DDA in the urine.

V. TREATMENT

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

Remove from exposure. Immediately flush eyes with water and wash skin with soap or mild detergent and water. If swallowed and the person is conscious, induce vomiting. Give artificial resuscitation and administer oxygen if indicated. Observe for convulsions and initiate appropriate treatment.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

DDT affects the nervous system and at high doses may cause convulsions. Skin absorption of DDT solutions is known to occur. Administration to animals has caused liver and other cancers. It is important that the physician become familiar with plant operating conditions in which exposure to DDT 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 DDT:

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 convulsive disorders would be expected to be at increased risk from exposure. Examination of the nervous system, kidneys and liver 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: "DDT (2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane)," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, pp.67-68.
2. Hygienic Guide Series: "DDT," American Industrial Hygiene Association Journal, 20:433-434, 1959.
3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1346-1350.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

4. International Agency for Research on Cancer: IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, Vol. 5, Some Organochlorine Pesticides, Lyon, France, 1974, pp. 90-124.
5. 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, pp. 58-62.
6. Laws, E.R., Jr., et al: "Long-Term Occupational Exposure to DDT - Effect on the Human Liver," Archives of Environmental Health, 27:318-321, 1973.
7. Wolfe, H.R. and J.F. Armstrong: "Exposure of Formulating Plant Workers to DDT," Archives of Environmental Health, 23:169-176, 1971.
8. Hayes, W.J., Jr., et al: "Evidence of Safety of Long-Term, High, Oral Doses of DDT for Man," Archives of Environmental Health, 22:119-135, 1971.
9. Laws, E.R., Jr., et al: "Men with Intensive Occupational Exposure to DDT - A Clinical and Chemical Study," Archives of Environmental Health, 15:766-775, 1967.
10. Gleason, M.N., et al: Clinical Toxicology of Commercial Products (3d ed.), Williams and Wilkins Company, Baltimore, 1969, Section III, pp. 83-85.
11. Palmer, K.A., et al: "Dominant Lethal Study of p,p'-DDT in Rats," Food and Cosmetics Toxicology, 11:53-62, 1973.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

REFERENCES AND SOURCES

DDT

1910.1000

- (f) Personal Protective Equipment, and, (h) Sanitation
- Eye: Grant, "Toxicology of the Eye;" American Industrial Hygiene Association, "Hygienic Guide Series"
- Skin: Sax, "Dangerous Properties of Industrial Materials;" Gleason, "Clinical Toxicology of Commercial Products;" American Industrial Hygiene Association, "Hygienic Guide Series;" Stolman, "Progress in Chemical Toxicology;" Patty, "Industrial Hygiene and Toxicology;" International Labour Office, "Encyclopedia of Occupational Health and Safety;" Thienes and Haley, "Clinical Toxicology;" Hamilton and Hardy, "Industrial Toxicology;" Spector, "Handbook of Toxicology"
- Ingestion: Sax, "Dangerous Properties of Industrial Materials;" Thienes and Haley, "Clinical Toxicology;" Gleason, "Clinical Toxicology of Commercial Products;" Patty, "Industrial Hygiene and Toxicology;" Stecher, "The Merck Index," eighth edition; International Labour Office, "Encyclopedia of Occupational Health and Safety;" Spencer, "Guide to the Chemicals Used in Crop Protection"

COMMENTS

- Eye - Classification: 2 and 6
Output statement numbers: 10 and 12 combined
Exceptions: None

According to Grant, DDT has "not been demonstrated to have a selective toxic effect on the eyes. Pure DDT dissolved in purified kerosene was tested in a concentration of 0.01% on a human eye and caused no discomfort or irritation; it also proved innocuous at 4% concentration tested on rabbit eyes. Rare instances have been reported of ocular irritation following contamination of the eye by powders containing DDT, and in one instance, chronic superficial punctate keratitis was associated with fatal poisoning from long exposure to the dust, but it is probable that constituents other than DDT were responsible, or that there was hypersensitivity."

The AIHA reports that "heavy exposure to DDT dust may result in eye . . . irritation," but further adds that this irritation is "chiefly mechanical" in origin.

The compound is concluded to warrant classifications of 2 and 6.

- Skin - Classification: 2 and 6
Output statement numbers: 2, 5b, 7a, 17g, 17i
Exceptions: None
- Sax notes that "DDT is not . . . absorbed from the skin unless it is in solution. Solutions are absorbed from the skin and, by the same token, emulsions are absorbed to some extent." According to Gleason, "oils, fats, and lipid solvents from any source, . . . enhance the absorption of DDT from all sites, including intact skin." The AIHA agrees, saying "prolonged skin contact with oil solutions may produce

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

dermatitis and possibly excessive absorption."

Stolman states, "DDT powder does not irritate the skin nor is it absorbed through the skin . . ." Hamilton and Hardy note, "dusts containing 5 per cent DDT have been applied to the skin in louse control programs for extended periods without untoward effects."

According to Patty, "experiments by Draize et al. indicated that dusts and solutions of DDT may cause a slight to moderate erythema on the skin. Using dry dusts of 5% DDT in talc, they were unable to find any indications of systemic toxic effect from absorption following the application of the 10 per cent solution of DDT in corn oil in doses up to 940 mg of DDT/kg solutions of 30 and 25 per cent DDT in dimethylphthalate and dibutylphthalate caused no deaths but toxic symptoms were observed from a dose of 9.4 mg/kg for a 24-hour exposure. These same authors ran 90-day repeated applications. They found that doses as low as 0.5 ml of a 30 per cent solution of DDT/kg/day (150 mg/kg/day of DDT) in rabbits, rats, and guinea pigs may cause death in some cases after 30 days."

The ILO reports, "when absorbed in sufficient quantity DDT produces a state of hyperexcitability, marked tremors, and increased rate of respiration, weakness and death which is usually preceded by clonic or asphyxial convulsions."

Sax notes that "DDT acts on the central nervous system, but the exact mechanism of this action either in man or in animals has not been elucidated." Gleason further adds that "DDT acts primarily on the central nervous system of man; the cerebellum and higher motor cortex appear to be the chief sites of action. Clinical manifestations include paresthesias, tremors, and convulsions. In addition, peripheral neuropathy has been rarely ascribed to DDT, usually to a chronic occupational exposure. In acute exposures, recovery is usually complete or well advanced in 24 hours. Aside from peripheral neuropathies and aplastic anemia, no clinical syndrome of chronic intoxication is recognized in man."

Thienes and Heley say that mild poisoning "results in feelings of tiredness, heaviness and aching of the limbs, headache, paresthesia of tongue, lips and face, nervous irritability, apprehension and mental sluggishness." Larger doses result in "dizziness, disturbance of equilibrium, confusion, mydriasis, loss of vibratory sense of fingers and toes, tremors, nausea and vomiting, fibrillary, clonic and tonic convulsions followed by coma. There may be fever."

Spector give the cutaneous LD50 for the rat as 3000 mg/kg and for the rabbit as 300 mg/kg.

DDT has a vapor pressure at 20 degrees C of 1.5 times ten to the negative seventh mm of Hg and is 0.00001% soluble in water.

From the above information, it is evident that any harmful effects from skin contact with this compound can be prevented if repeated or prolonged contact is disallowed. Consequently,

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

the substance is assigned classifications of 2 and 6.
Ingestion - Classifications: 1 and 5

Output statement numbers: 19, 20b

Exceptions: None

Sax reports that "DDT is rapidly absorbed from the intestinal tract" and "acts on the central nervous system." Thienes and Haley, however, note that "the dry powder is poorly absorbed from the alimentary tract; oil solutions are . . . readily absorbed from the digestive tract."

Gleason gives the symptoms of DDT poisoning, occurring in usually 2 - 3 hours after ingestion, as "vomiting, due to local gastric irritation. Delayed emesis and/or diarrhea may occur. Paresthesias, usually first of the lips, tongue, and face. Malaise, headache, sore throat, fatigue. Coarse tremors, apprehension, ataxia and confusion. Convulsions, both clonic and tonic. Death is usually due to respiratory failure from medullary paralysis. In acute exposures, recovery is usually complete within 1 to 3 days, but sometimes weakness or paralysis may persist for weeks."

Thienes and Haley state that the "acutely toxic dose is probably 1 gm and the estimated fatal dose 30 gm. Daily ingestion of a diet containing 1 part of DDT in 10,000 parts of food caused convulsions in experimental animals after a period of 2 months. One-half mg per kg per day for man is not toxic, but 5 times this amount causes symptoms. The officially permissible concentration of DDT in food is 0.049 grains per pound, or 7 ppm. No DDT is permitted in milk." Thienes and Haley further note that the "one established case of fatal DDT poisoning died four hours after taking the poison. Animals live for several hours to two or three days before succumbing to a single fatal dose. At death from acute poisoning, ventricular fibrillation has been observed. In chronic poisoning of animals, death may occur from inanition, due to anorexia, or to hepatic necrosis."

According to Patty, "Woodard et al. investigated the acute oral toxicity of DDT. They reported some deaths in rats at 140 mg/kg. Rabbits survived 260 mg/kg and some died at 400 mg/kg. Mice survived 399 mg/kg and some died at 448 mg/kg. Guinea pigs survived 178 mg/kg and some died at 224 mg/kg. Lehman reported the approximate LD50 for rats as 250 mg/kg." Rats fed a diet of DDT for 2 years at concentrations of 600 and 800 ppm by weight showed "moderate tremors, particularly during early exposures. Concentrations of 400 ppm and above showed a higher than normal mortality," as well as an "increase in weight of the liver. There were some slight indications of liver damage, even at 100 ppm. Treon indicated that rats maintained from 18 months to 2 years on a diet containing 25 ppm by weight of DDT showed an increase in liver weight. Lang et al. indicated that hepatic cell alternations were seen at 5 ppm in the diet and higher but not at 1 ppm. They observed an accumulation of DDT in body fat, even at 1 ppm in the diet."

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

According to Stecher, the acute toxic symptoms of DDT poisoning are given as "tremors of the head and neck muscles, tonic and clonic convulsions, cardiac or respiratory failure, death. Estimated oral fatal dose 500 mg/kg body weight of the solid material. Solvents . . . increase toxicity. Death occurs in 2 to 24 hours." The chronic symptoms are given as "hepatic damage, CNS degeneration, agranulocytosis, dermatitis, weakness, convulsions, coma and death."

The ILO lists DDT as a "potential occupational carcinogenic" chemical. The ILO further adds that "in edible oils, the LD50 for rats may have a range of 100 - 350 mg/kg of body weight; however, the LD50 for dry powder or aqueous suspension is of the order of 1400 mg/kg. In oil solutions, the LD50 for all solutions in rabbits is 930 - 1940 mg/kg."

According to Spencer, "acute oral LD50 to male white rats 113 mg/kg. Little evidence that the chronic toxicity is high but there is storage of DDT in the body fats and excretion in milk introducing an indeterminate hazard into the use of DDT for fly control in milk production."

The cumulative nature of DDT in body fat and the fact that it is potentially carcinogenic lead to the conclusion that classifications of 1 and 5 are appropriate.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition (K-O)
"Merck Index," 8th edition (Merck)

Sources of data items used:

- I. A. 1. Synonyms: K-O
2. Formula: Merck
3. Molecular weight: Merck
- B. 1. Boiling point: ADL
2. Specific gravity: K-O
3. Vapor density: Not applicable
4. Melting point: K-O
5. Vapor pressure: K-O
6. Solubility in water: K-O
7. Evaporation rate: Not applicable
8. Appearance and odor: K-O, ADL
- II. A. 1. Flammability: Not combustible
- B. 1. Conditions contributing to instability: K-O
2. Incompatibilities: ADL
3. Hazardous decomposition products: ADL
4. Special precautions: None
- III. A. Steps if released or spilled: ADL
C. Waste disposal method: ADL
- V. Miscellaneous precautions: ADL

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

"DDT," American Conference of Government Industrial Hygienists, Hygienic Guide Series, October 1959 (Hygienic Guides)
Edmundson, W. F., Davies, J. E., Cramer, M. and Nachman, G. A., "Levels

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

of DDT and DDE in Blood and DDA in Urine of Pesticide Formulators Following a Single Intensive Exposure," Industrial Medicine 38:55 - 60, 1969 (Edmundson)

Laws, E. R., Jr., Curley, A. and Biros, F. J., "Men with Intensive Occupational Exposure to DDT - A Clinical and Chemical Study," Archives of Environmental Health, 15:766 - 775, 1967 (Laws)

Ortlee, M. F., "Study of Men with Prolonged Intensive Occupational Exposure to DDT," Archives of Industrial Health, 18:433 - 439, 1958 (Ortlee)

Wolfe, H. R., Durham, W. F. and Armstrong, J. F., "Exposure of Workers to Pesticides," Archives of Environmental Health, 14:622 - 633, 1967 (Wolfe and Durham)

Wolfe, H. R. and Armstrong, J. F., "Exposure of Formulating Plant Workers to DDT," Archives of Environmental Health, 23:169 - 176, 1971 (Wolfe)

References for Specific Use/Exposure

1. Ortlee, Laws, Wolfe, Edmundson
2. Ortlee, Laws
3. Wolfe and Durham

References for Specific Control Methods

Hygienic Guides were the references used in numbers 1 and 2.

3. Hygienic Guides, ADL estimate

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: DDT

D. O. L. STANDARD: 1 mg/M3

WARNING PROPERTIES: Since DDT has a negligible vapor pressure, warning properties are not considered.

Eye Irritation Level: Grant states that DDT "has not been demonstrated to have a selective toxic effect on the eyes. Pure DDT dissolved in purified kerosene was tested in a concentration of 0.01% on a human eye and caused no discomfort or irritation; it also proved innocuous at 4% concentration tested on rabbit eyes. Rare instances have been reported of ocular irritation following contamination of the eye by powders containing DDT and in one instance chronic superficial punctate keratitis was associated with fatal poisoning from long exposure to the dust, but it is probable that constituents other than DDT were responsible, or that there was hypersensitivity." The AIHA Hygienic Guides note that any eye irritation which occurs is "chiefly mechanical."

For the purposes of this standard, quarter- and half-facepiece respirators are permitted.

IDLH: There is no evidence in the available toxicological information that an acute exposure to a high concentration of DDT would impede escape or cause any irreversible health effects within one-half hour. The AIHA Hygienic Guides state that the IDLH concentration is "probably unattainable" and that DDT has a low order of acute toxicity by inhalation. For the purposes of this standard, therefore, respirators have been assigned on the basis of the protection factor afforded by each device. It is recognized, however, that for some substances for which there does not appear to exist a concentration immediately dangerous to life and health, the determination of allowable respiratory protection based on protection factors may result in the selection of a concentration which is not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

determined that only those respirators allowed for use above IDLH concentrations are permitted for use in concentrations exceeding 500 times the permissible exposure.

Other Toxicological Information: The AIHA Hygienic Guides state that the severity of the health hazard of DDT is "moderate for repeated inhalation exposure; low for acute inhalation, ingestion and absorption through the skin. Heavy exposure to DDT dust may result in eye and skin irritation, chiefly mechanical . . . Ingestion of approximately one gram of DDT per day in adults probably required to produce significant chronic cumulative poisoning . . . DDT affects the central nervous system and may produce liver damage following chronic exposure."

According to the AIHA Hygienic Guides, the atmospheric concentration immediately hazardous to life is "unknown and probably unattainable."

The Documentation of TLV's states that "the U.S. Public Health Service reported that human volunteers breathed 423 mg/M3 of DDT for periods of one hour a day for six days. The only ill effect was eye irritation." The Documentation presents mainly oral data in discussing the toxicity of DDT.

"So far as acute toxicity is concerned, it is known that a single dose of 286 mg produced mild poisoning in a sick man weighing 47.5 kg. A single ingestion at the rate of about 10 mg/kg produces moderate illness in some people, but not all even though no vomiting occurs; a single dosage at the rate of 16 mg/kg frequently leads to convulsions. The limit of 1 mg/M3 is sufficiently low to prevent acute poisoning by a large margin of safety and to prevent significant accumulation in body stores."

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DDT

USE/EXPOSURE AND CONTROL DOCUMENT
DDT

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of dust and skin contact with liquid during preparation and handling of insecticide formulation (including emulsifiable concentrates, wettable powders, and dusts)	A,D	Process enclosure; general ventilation; impervious protective clothing and gloves; air mask
2.	Inhalation of dust during synthesis and handling of substance	A	Process enclosure; general ventilation; impervious protective clothing and gloves; air mask
3.	Inhalation of dust or mist and skin contact with liquid during application of insecticide	A,D	Impervious protective clothing and gloves; air mask

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

Note: Registration cancelled - EPA ordered a general ban on the registration of DDT in January 1973. Since this is still in effect, no DDT is being used in the U.S., although some is still being manufactured (and presumably formulated) for export.