

**NIOSH**

**criteria for a recommended standard . . . .  
occupational exposure to**

**PARATHION**



**criteria for a recommended standard....**

**OCCUPATIONAL EXPOSURE  
TO  
PARATHION**



**U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE  
Public Health Service  
Center for Disease Control  
National Institute for Occupational Safety and Health  
June 1976**

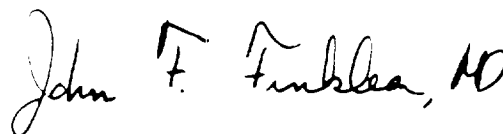
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## PREFACE

The Occupational Safety and Health Act of 1970 emphasizes the need for standards to protect the health and safety of workers exposed to an ever-increasing number of potential hazards at their workplace. The National Institute for Occupational Safety and Health has projected a formal system of research, with priorities determined on the basis of specified indices, to provide relevant data from which valid criteria for effective standards can be derived. Recommended standards for occupational exposure, which are the result of this work, are based on the health effects of exposure. The Secretary of Labor will weigh these recommendations along with other considerations such as feasibility and means of implementation in developing regulatory standards.

It is intended to present successive reports as research and epidemiologic studies are completed and sampling and analytical methods are developed. Criteria and standards will be reviewed periodically to ensure continuing protection of the worker.

I am pleased to acknowledge the contributions to this report on parathion by members of my staff, the valuable and constructive comments presented by the Review Consultants on Parathion, by the ad hoc committees of the American Academy of Occupational Medicine and the American Conference of Governmental Industrial Hygienists, by Robert B. O'Connor, M.D., NIOSH consultant in occupational medicine, and by Bruce J. Held on respiratory protection. The NIOSH recommendations for standards are not necessarily a consensus of all consultants and professional societies that reviewed this criteria document on parathion. Lists of the NIOSH Review Committee members and of the Review Consultants appear on the following pages.

A handwritten signature in black ink that reads "John F. Finklea, MD". The signature is written in a cursive style with a large, stylized initial "J".

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The Division of Criteria Documentation and Standards Development, National Institute for Occupational Safety and Health, had primary responsibility for development of the criteria and recommended standard for parathion. The Division review staff for this document consisted of J. Henry Wills, Ph.D., Herbert E. Christensen, D.Sc., and Richard A. Rhoden, Ph.D., with Charles C. Hassett, Ph.D. and Seymour D. Silver, Ph.D. (consultants).

The Sequoia Groups, Berkeley, California, developed the basic information for consideration by NIOSH staff and consultants under contract No. HSM-99-72-35. Jon R. May, Ph.D., had NIOSH program responsibility and served as criteria manager.

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# I. RECOMMENDATIONS FOR A PARATHION STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that employee exposure to parathion in the workplace be controlled by adherence to the following sections. The standard is designed to protect the health and safety of workers for up to a 10-hour work shift, 40-hour workweek during a working lifetime. Compliance with all sections of the standard should prevent adverse effects by parathion on the health and safety of employees. The standard is measurable by techniques that are valid, reproducible, and available to industry and government agencies. Sufficient technology exists to permit compliance with the recommended standard. The criteria and standard will be subject to review and revision as necessary.

“Parathion” is defined as O,O-diethyl O-p-nitrophenyl phosphorothioate, regardless of production process, alone or in combination with other compounds. “Occupational exposure to parathion” is defined as employment in any area in which parathion or materials containing parathion, alone or in combination with other substances, is produced, packaged, processed, mixed, blended, handled, stored in large quantities, or applied. If employees are potentially exposed to other chemicals, such as pesticide vehicles, diluents, or emulsifiers, or other pesticides, provisions of any applicable standards for such other chemicals shall also be followed. Adherence to all provisions of the standard is required in workplaces using parathion regardless of the airborne parathion concentration because of serious effects produced by contact with the skin, mucous membranes, and eyes. Since parathion does not irritate or burn the skin, no warning of skin exposure is likely to occur. However, parathion is readily absorbed through the skin, mucous membranes, and eyes and presents a potentially great danger from these avenues of absorption. It is extremely important to emphasize that available evidence indicates that the greatest danger to employees exposed to parathion is from SKIN CONTACT.

## Section 1—Environmental (Workplace Air)

### (a) Concentration

Occupational exposure to parathion shall be controlled so that no employee is exposed to parathion in a concentration greater than 0.05 mg/m<sup>3</sup> of air determined as a time-weighted average (TWA) exposure for up to a 10-hour work shift and a 40-hour workweek.

### (b) Sampling and Analysis

Procedures for collection and analysis of environmental samples shall be as provided in Appendices I and II or by any method shown to be at least equivalent in accuracy, precision, and sensitivity to those specified.

## Section 2—Medical

Medical surveillance (biologic monitoring and medical management) shall be made available to workers as outlined below. Physicians responsible for workers who may be occupationally exposed to parathion should be familiar with the information contained in Appendix IV which describes the diagnosis and treatment of intoxication by this compound.

### (a) Medical Examinations

(1) Preplacement and periodic medical examinations shall include:

(A) Comprehensive initial or interim medical and work histories.

(B) A physical examination which shall be directed towards, but not limited to, evidence of frequent headaches, dizziness, nausea, tightness of the chest, dimness of vision, and difficulty in focusing the eyes. Those workers with a history of glaucoma, cardiovascular disease, hepatic disease, renal disease, or central nervous system abnormalities should be considered for exclusion from assignments requiring exposure to parathion.

(C) Initial medical examinations shall be made available to all workers within 60 days of the promulgation of this recommended standard.

(D) Periodic examinations shall be made available on an annual basis or at some other interval determined by the responsible physician.

(E) Determination, at the time of the preplacement examination, of a baseline or working baseline erythrocyte cholinesterase activity (See Section (b) Biologic Monitoring).

(F) A judgment of the worker's physical ability to use negative or positive pressure respirators as defined in 29 CFR 1910.134.

(2) Emergency first-aid services shall be established, under the direction of the responsible physician, to provide care to any worker acutely intoxicated by parathion (See Appendix IV).

(3) Appropriate medical services and surveillance shall be provided to any worker with adverse health effects reasonably assumed or shown to be due to occupational exposure to parathion.

(4) Medical records shall be maintained for

all workers occupationally exposed to parathion and such records shall be kept for at least 5 years after termination of employment.

(5) Pertinent medical information shall be available to the designated medical representatives of the Secretary of Health, Education, and Welfare, of the Secretary of Labor, of the employee or former employee, and of the employer.

(b) Biologic Monitoring

(1) Definitions

(A) "Preexposure baseline" for erythrocyte cholinesterase is defined as the mean of 2 cholinesterase activity determinations, each of which is derived from a separate sample of blood taken at least 1 day apart, after a period of at least 60 days without known exposure to any cholinesterase-inhibiting compounds. If the determinations produce values differing by more than 15%, additional determinations on new samples must be performed until successive tests do not differ by more than 15%.

(B) "Working baseline" for erythrocyte cholinesterase is defined as the mean of 2 cholinesterase activity determinations, each of which is derived from a separate sample of blood taken at least 1 day apart and differing by no more than 15%, or the arithmetic mean of normal values for an appropriate control population of adults for that laboratory, whichever is higher. A "working baseline" is determined only for an individual whose work history does not permit a preexposure baseline to be determined as specified in paragraph (b)(1)(A) of this section.

(C) "Mean of normal values" is defined as the arithmetic mean of erythrocyte cholinesterase activities for healthy adults as determined by the laboratory's experience with repeated analyses, but which is not inconsistent with the mean baseline activities presented in Table XI-2 of Appendix III.

(2) Routine Monitoring

(A) All employees who are to be occupationally exposed to parathion shall have preexposure erythrocyte cholinesterase baselines determined whenever their work history allows an accurate preexposure determination, as specified in paragraph (b)(1)(A) of this section. Those new employees with work histories precluding preexposure baseline cholinesterase determinations shall have working baseline determinations performed.

(B) Within 60 days after the effective date of a standard based on this recommendation, all present employees occupationally exposed to parathion shall have working baseline erythrocyte cholinesterase activity determined.

(C) Subsequent to the determination of a preexposure or working baseline, each employee occupationally exposed to parathion shall have his erythrocyte cholinesterase activity determined at 4-week intervals, except for those employees in the following occupations: (1) mixers, loaders, ground applicators, flaggers, and manufacturing or formulating employees working with other than closed production, mixing, blending, transfer, and packaging systems—all of whom shall be tested at 1-week intervals. This 1-week interval shall be reduced to testing every 3 days for any employee working with parathion for a period exceeding 12 hours during any workday. This shorter interval shall be maintained until at least one entire workweek has elapsed without a workday exceeding 12 hours; (2) personnel who clean or repair equipment or clean parathion spills and aerial applicators (ie, agricultural pilots) not engaged in loading operations shall be tested at 2-week intervals.

(D) Unacceptable absorption of parathion indicating a failure of control procedures and/or work practices is demonstrated when the enzymic activity of erythrocyte cholinesterase is decreased to between 60-70% of the employee's preexposure baseline or working baseline level. The employee shall be advised of this finding and an industrial hygiene survey shall be conducted in the workplace of the affected employee unless the cause of the exposure is known and corrective action has been initiated. This survey shall include an assessment of the dermal exposure potential. Based on the results of this survey, necessary corrective action shall be accomplished.

In addition an employee whose erythrocyte cholinesterase determination, as required by paragraph (b)(2) of this section or (a)(5) of Section 6, indicates that his erythrocyte cholinesterase activity is decreased to 60% or below of his preexposure baseline or working baseline shall be removed from potential exposure to parathion and placed under medical observation. In such cases, an industrial hygiene survey shall be conducted in the workplace of the affected employee unless the cause of the exposure is known and corrective action has been taken. This survey shall include an assessment of the dermal exposure potential. Based on the results of this survey necessary corrective action shall be accomplished.

(E) An employee who has been removed from parathion exposure shall not be allowed to return to work involving occupational parathion exposure until his erythrocyte cholinesterase ac-

tivity has returned to at least 75% of the working or preexposure baseline values or unless the responsible physician has approved his return.

(F) Each employee shall be given a copy of the results of his initial and periodic tests, and of any special cholinesterase test results as soon as possible after the test, plus an interpretation.

(3) Blood Collection and Analysis

Procedures for collection and analysis of blood samples for RBC ChE activity shall be as provided in Appendix III or by any method shown to be at least equivalent in accuracy, precision, and sensitivity to those specified.

### Section 3—Labeling and Posting

(a) Labeling

Containers of parathion used in the workplace shall be labeled with at least the following information:

DANGER! POISON  
CONTAINS PARATHION  
EXTREME HEALTH HAZARD (includes skin)  
CAN BE FATAL { If Swallowed  
                  { If Left on Skin  
                  { If Heated and Inhaled

If parathion is dissolved in a combustible solvent, the label shall include a statement of flammability appropriate to the solvent.

The following list of safe work practices and emergency information shall be made available to each employee as informational material.

### SAFE WORK PRACTICES

Do NOT breathe vapor, mist, or dust or allow to get into eyes, on skin, or on clothing. Do not rub eyes or face with hands or clothing.

When possibility of contact exists:  
Wear full-body coveralls or impervious apron, goggles, impervious boots and gloves, and, if required, a respirator.

**WARNING** — Can penetrate leather or canvas shoes and sneakers.

Use fresh clothing daily.  
Shower with soap and water before leaving work.  
Do not wear work clothes home.

Wash hands thoroughly with soap and water before eating, chewing gum, smoking, defecating, or urinating. Store food and tobacco away from work area. Keep containers tightly closed whenever unattended. Protect concentrated parathion from all sources of ignition. Do not warm concentrated parathion containers with open flame. Do not smoke while handling parathion.

### EMERGENCY INFORMATION

If liquid gets on skin, wash immediately with alkaline soap and water and call a physician. If clothes become contaminated, remove at once. Then wash your body with soap and water and call a physician. If sickness occurs while handling materials containing parathion, or after handling such materials, call a physician. **NOTE:** Poisoning symptoms may occur several hours after work ends. If possible, take this label to the physician along with the patient.

**IN CASE OF FIRE,** use supplied-air respirator. Burning may produce highly poisonous combustion products.

In case of spills, accidental discharges, leaks, ruptures, or other sources of contamination of equipment, facilities, or ground, place contaminated area or items under continuous surveillance, then decontaminate with strong alkali or other suitable decontaminating materials.

(b) Posting

(1) The following sign shall be posted in a readily visible location at or near all entrances to manufacturing, formulating, and storage areas in which there is occupational exposure to parathion:

POISON AREA  
PARATHION  
CAN BE FATAL { If Swallowed  
                  { If Left on Skin  
                  { If Heated and Inhaled

Use required personal protective equipment and clothing.

If **SKIN** contact occurs, wash immediately with alkaline soap and water and call a physician.

If **CLOTHES** are contaminated, go to a clean area and remove quickly.

Wash skin with soap and water.  
Put on clean clothes and call a physician.

**DO NOT SMOKE, EAT, OR SLEEP IN AREA.**

Warning signs shall be printed in English and in the predominant language of non-English-reading employees. Employees unable to read posted warnings and labels and those unfamiliar with English or with the predominant non-English lan-

guage shall receive periodic training sufficient to ensure their understanding of the contents of the label and poster specified in this section, and to provide a continuing reminder of these contents.

(2) The following poster shall be securely attached beside the entrance to any vehicle (eg, truck, freight car) used to transport parathion at all times that parathion is contained therein:

DANGER — POISON  
CONTAINS PARATHION  
IF LIQUID OR POWDER HAS LEAKED,  
DO NOT ENTER  
CAN BE ABSORBED THROUGH SKIN  
OR BY BREATHING  
IF SKIN CONTACT OCCURS,  
WASH IMMEDIATELY  
WITH ALKALINE SOAP AND WATER  
AND CALL A DOCTOR AT ONCE

#### **Section 4—Personal Protective Equipment and Protective Clothing**

##### **(a) Skin Protection**

(1) Unless separately provided in this section, an employee who engages in filling, pouring, mixing, formulating, loading, applying, or otherwise handling parathion (including in open-system manufacturing processes) shall be provided with, and required to wear, protective head covering; goggles or face shield; impervious gloves; full-body coveralls, impervious apron, or impervious rainsuit; and impervious footwear. Impervious gloves should have reverse gauntlets and coveralls should be of a closely-woven material (siliconized fabric [nylon or cotton] is especially protective) without cuffs. Whenever the word impervious appears in this document, it means highly resistant to the penetration of parathion.

(2) Employees handling sealed, nonleaking containers of parathion shall be provided with, and required to wear, full body coveralls and impervious gloves.

(3) Employees operating open equipment for ground (non-aerial) application of parathion shall be provided with, and required to wear, a protective head covering, preferably wide-brimmed and waterproof, or face shield, impervious gloves, full-body coveralls or an impervious rainsuit, and impervious footwear.

(4) Employees applying parathion by closed-cockpit aircraft shall be provided with im-

pervious gloves. Employees applying parathion by open-cockpit aircraft shall be provided with, and required to wear, full-body coveralls or impervious rainsuit, goggles, and impervious gloves.

(5) Employees acting as flaggers (other than those flagging from enclosures) in the aerial application of parathion shall be provided with, and required to wear, full-body coveralls or impervious rainsuit, a protective head and neck covering (preferably wide-brimmed and waterproof), impervious footwear, and impervious gloves.

(6) Where toxic residues present a reasonable potential for exposure, employees entering areas treated with parathion shall be provided with, and required to wear, impervious gloves, full-body coveralls or impervious rainsuit, face shield if foliage is likely to contact the face, and impervious footwear.

(7) Employees (such as cleanup personnel) entering areas contaminated with parathion shall be provided with, and required to wear, impervious gloves, full-body coveralls or impervious rainsuit, impervious footwear, impervious apron, and such other personal protective equipment as may be required for adequate protection against the particular hazards presented.

(8) Laundry personnel handling clothing contaminated with parathion shall be provided with, and required to wear, impervious gauntlet gloves, impervious shoes, and, in addition to ordinary clothes, an impervious apron.

(9) The employer shall ensure that all personal protective devices are inspected regularly and maintained in clean and satisfactory working condition.

(10) Protective clothing shall not be taken home by employees. The employer shall provide for maintenance and laundering of protective clothing.

##### **(b) Respiratory Protection**

(1) Engineering controls shall be used wherever feasible to maintain airborne parathion concentrations below the workplace air limit specified in Section 1(a). Compliance with the workplace environmental limit may not be achieved by the use of respirators except:

(A) During the installation, testing, maintenance, or repair of required engineering controls.

(B) For nonroutine operations, such as maintenance or repair activities, where brief exposure to parathion at concentrations in excess of the permissible exposure limit could occur.

(C) During emergencies.

(2) When a respirator is permitted by paragraph (b)(1) of this section, it shall be selected and used in accordance with the following requirements:

(A) For the purpose of determining the type of respirator to be used, other than supplied-air positive pressure respirators, the employer shall make a determination of the atmospheric concentration of parathion in the workplace initially (and thereafter whenever pertinent working conditions are altered) and shall choose the appropriate respiratory protective device specified in Table I-1. The employer shall ensure that no employee is being exposed to parathion in excess of the limit specified in Section 1(a) because of improper respirator selection, fit, use, or maintenance, or because of changes in working conditions.

(B) Employees experiencing breathing difficulties while wearing respiratory protective devices shall be medically examined to determine their ability to wear such devices. If it is determined that an employee cannot breathe adequately while wearing a respirator, the employee shall not be allowed to work in any operation requiring the use of a respirator. This provision shall not relieve the employer of any of the requirements of Section 2(a).

(C) A respiratory protective program meeting the requirements of 29 CFR 1910.134 and 30 CFR 11 which incorporates the American National Standard Practices for Respiratory Protection Z88.2-1969 shall be established and enforced by the employer.

(D) The employer shall provide respirators in accordance with Table I-1 and shall ensure that the employee uses the respirator provided.

(E) Respiratory protective devices described in Table I-1 shall be those approved under the provisions of 29 CFR 1910.134 and 30 CFR 11.

(F) Canisters or cartridges shall be discarded and replaced with fresh canisters or cartridges in accord with the manufacturer's specifications, or if the odor of parathion, parathion-containing formulations, diluents, emulsifiers, or solvents is detected while using the respirator, or if a breakthrough-indicator (if any) indicates the absorbent is saturated, whichever occurs first. Filters shall be changed whenever canisters or cartridges are changed, or after every 4 hours of use, or if breathing becomes difficult, whichever occurs first. Unused canisters or cartridges shall be discarded and replaced when the seals are broken, or on the expiration of the manufacturer's recommended storage life if the seals are unbroken.

(G) The employer shall ensure that respirators are adequately cleaned and maintained, and that employees are instructed on the use of respirators assigned them and on methods for leakage testing.

(H) Respirators specified for use in higher concentrations of airborne parathion may be used in atmospheres with lower concentrations.

(I) Respirators, except cooled supplied-air type, shall not be used for more than 15 minutes if ambient temperature exceeds 85°F in the particular workplace, except in emergencies.

(J) Where an emergency may develop which could result in overexposure of employees to parathion, the employer shall provide respiratory protection as indicated in Table I-1.

(3) For purposes of this section, the application of parathion formulations is not to be considered a nonroutine operation for which respirators may be used in exposure situations where the environmental limit is exceeded. Engineering controls, such as enclosed filtered-air tractor cabins and aircraft cockpits, shall be used where the environmental conditions encountered or the application method selected present a reasonable likelihood of the environmental limit being exceeded. Where filtered-air enclosures are used, air levels of parathion shall be regularly monitored to ensure compliance with the standard.

#### **Section 5—Informing Employees of Hazards from Parathion**

(a) Before work involving occupational exposure to parathion begins, all new or reassigned employees shall be informed of the hazards of parathion, relevant symptoms of overexposure to parathion, appropriate emergency procedures, and the conditions and precautions required for safe handling of parathion.

(b) Within 30 days after promulgation of a standard based on these recommendations, all employees whose duties currently involve potential exposure to parathion shall be informed as in paragraph (a) of this section.

(c) A program of employee education shall be instituted within 30 days after the effective date of a parathion standard. The program shall be designed to ensure that all employees occupationally exposed to parathion understand and remain aware of job hazards as well as emergency, maintenance, and cleanup procedures, and that they know how to correctly use and maintain respiratory protective equipment and protective clothing. The training shall be repeated at least annually after the employee's initial training required

**TABLE I-1**  
**RESPIRATOR SELECTION GUIDE FOR PROTECTION**  
**AGAINST PARATHION**

Concentration of Parathion	Respirator Type
0.5 mg/cu m or less	Half-mask pesticide respirator. or Type C supplied-air respirator, demand type (negative pressure), with half-mask facepiece
2.5 mg/cu m or less	Fullface gas mask (chin-, chest-, or back-mounted type) or Type C supplied-air respirator, demand type (negative pressure), with full facepiece.
50 mg/cu m or less	Type C supplied-air respirator, continuous flow type with full facepiece or suit or Pressure-demand type respirator with full facepiece and impervious plastic shroud
Emergency (includes entry into vessels, bins, or other containers which are probably contaminated with parathion)	Self-contained breathing apparatus with positive pressure in full facepiece or Combination supplied-air respirator, pressure demand type with auxiliary self-contained air supply

under this paragraph.

(d) In addition to the requirements of paragraph (c) above, employees occupationally exposed to parathion shall be kept currently informed through posting as specified in Section 3(b) and shall be instructed as to the availability of biologic monitoring information. The information specified in Section 2(b)(2) shall be kept on file and shall be readily accessible to each employee at or near each workplace where exposure to parathion may occur. In addition, each employee shall be informed of his or her biologic monitoring results as specified in Section 2(b)(2)(F).

(e) Information as required shall be recorded on the "Material Safety Data Sheet" shown in Appendix V, or on a similar form approved by the Occupational Safety and Health Administration, US Department of Labor.

**Section 6—Work Practices**

(a) Emergency Procedures

(1) Each employer shall contact and advise a physician, or other nearby medical service, that an emergency arising from exposure to parathion exposure can occur.

(2) Unless otherwise specified in this paragraph, employees occupationally exposed to parathion shall have provided to them in a readily accessible site either 25 gallons of water for each

person or 100 gallons, whichever is greater, plus alkaline soap and towels, for use in emergencies. Emergency water supplies are not required in agricultural aircraft. Tractors shall have at least 10 gallons of water stored in closed containers. Mixing vehicles shall have at least 20 gallons of water stored in closed containers.

(3) Parathion-manufacturing, -formulating, and fixed mixing facilities shall have emergency showers.

(4) Whenever parathion contaminates clothing or personal protective equipment, other than the outside of impervious clothing or respiratory protective devices, the employees shall move away from the possibility of further exposure. The contaminated articles shall be immediately removed and the employee required to wash with alkaline soap and water.

(5) Before removing externally contaminated impervious clothing, its surface shall be washed with alkaline soap and water or other decontaminant of equal or superior effectiveness.

(6) When an employer, a supervisor, or the affected employee suspects overexposure to parathion (eg, known exposure, obvious signs or symptoms of poisoning), the employee shall be placed under medical observation until a determination is made by the physician in accordance with Section 2(b)(2) that the employee is capable of returning to work.

(7) Persons responsible for fire protection shall be informed that formulations of parathion in combustible solvents are being used, of the high toxicity of the products of combustion, and of the necessity for using supplied-air respirators in suppressing fires involving parathion.

(8) Any emergency or accidental release (eg, application to incorrect field) of parathion from agricultural aircraft shall be reported immediately to people resident in the area and to appropriate local regulatory or health officials.

(b) Engineering Controls

(1) Engineering controls, such as process enclosures, filling equipment with automatic shutoff, mechanical metering and transferring devices, and ventilation systems, shall be used if necessary to ensure that the workplace environmental limit specified in Section 1(a) is not exceeded, and to minimize skin exposure to parathion.

(2) Control of Unit Operations

(A) Controls of unit operations of equivalent or superior effectiveness may be substituted for those specified in paragraphs (B) through (I) below.

(B) All fittings, hoses, tubing, pumps, valves, and associated equipment operated at positive pressure shall be sufficient to withstand 2½ times the maximum pressure normally encountered and shall be examined at least weekly for leaks and other signs of deterioration.

(C) All hoses, pipes, and tubing used for filling tanks on loading or application vehicles with parathion shall be equipped with quick-acting shutoff valves or other devices at the discharge ends to prevent dripping.

(D) Back siphoning by hoses used for filling vessels, tanks, or other containers with parathion, or for adding any other liquid if the container already contains parathion, shall not be permitted.

(E) When positive displacement pumps are used with hoses, pipes, or tubing equipped with shutoff valves at the discharge end, a relief device shall be installed to bypass liquid back to the low-pressure side of the system in order to prevent rupture of hoses, pipes, tubing, or pumps.

(F) All application equipment with 2 or more nozzles shall have the distribution manifold shielded to minimize operator exposure in the event of malfunction.

(G) Opaque tanks used for mixing, loading, or application of parathion shall be equipped with indicators of the level of liquid within the tank.

(H) Loading equipment shall be fitted with an automatic shutoff device to prevent overfilling.

(I) Tank covers shall be so constructed to minimize the possibility of contents spilling in the event of rollover or aerial accident.

(3) Ventilation

(A) If used, ventilation systems shall be designed to remove parathion from the breathing zones of exposed workers and to prevent the accumulation and recirculation of parathion in the workplace.

(B) Exhaust ventilation systems discharging into outside air shall conform to applicable local, state, and federal air pollution regulations.

(C) A program of periodic preventive maintenance, cleaning, and inspection shall be established to ensure maximum effectiveness of ventilation systems. This program shall include air-flow measurements, inspection of ductwork for leaks, and examination of the collecting element(s). These procedures shall be performed before manufacturing or formulating operations begin and at least twice monthly during manufacture or formulation.

(c) Storage

(1) All locations in which parathion is stored, or where access is not otherwise limited, shall be fenced and locked and shall be posted as specified in Section 3(b).

(2) Provisions for the storage of containers of parathion or its formulations are given in 29 CFR 1910.106. All parathion containers shall be protected from heat, corrosion, mechanical damage, and sources of ignition.

(3) Containers of parathion shall be inspected upon receipt, and at least monthly thereafter, for corrosion, leaks, breaks, tears, or other defects.

(4) Partially-full and empty parathion containers shall be tightly closed and kept in locked storage areas until disposed of properly, except where direct supervision is maintained continuously.

(5) Parathion shall only be stored in containers which bear the label required in Section 3(a).

(6) Containers which are normally used for storage or preparation of food, feed, or drink shall not be used for storage of parathion.

(7) No persons shall be allowed to eat, sleep, or smoke in any area in which parathion is stored.

(8) Outdoor storage facilities shall be



located at least 20 feet from any dwellings or populated area and shall be equipped with a sprinkler system, where feasible.

(d) Personal Hygiene

(1) The employer shall provide a changing area where street clothes may be stored free from contamination by parathion.

(2) All required personal protective clothing and protective equipment shall be provided and laundered or cleaned daily by the employer. The employer shall ensure that all impervious personal protective clothing is free from cracks, pinholes, or other signs of deterioration. Personal protective clothing grossly contaminated with parathion shall be decontaminated and laundered separately from other clothing.

(3) The employer shall make extra clothes available at each work site for use when protective or personal clothing becomes contaminated with parathion.

(4) Employees occupationally exposed to parathion shall be required to wash hands and face with alkaline soap and water before eating, drinking, smoking, or using toilets.

(5) Employees occupationally exposed to parathion shall be required to take a shower at the end of each workday before leaving work. The employer shall provide alkaline soap and clean towels.

(e) Housekeeping, Decontamination, and Waste Disposal

(1) All parathion spills shall be cleaned up as soon as possible. Continuous surveillance of spills shall be provided until decontamination is completed. Contaminated areas shall be roped off or access to them otherwise prevented. They shall also be posted.

(2) Spills of parathion on floors shall be absorbed with absorbing clay. Sweeping compound shall be utilized to facilitate the removal of all visible traces of parathion-contaminated clay.

(3) All floors that may be contaminated by parathion shall be decontaminated with a strong alkaline solution, or with an equivalent or superior decontaminating solution, at least weekly.

(4) Equipment or fixtures contaminated with parathion, including operator compartments or control positions on application and loading equipment, shall be washed with a strong alkaline solution, or with an equivalent or superior decontaminating solution, as soon as possible.

(5) Drip pans containing absorbent material shall be utilized to facilitate decontamination in locations where leakage is likely to occur.

(6) Unless otherwise provided by local, state, or federal regulation, clothing, rags, bags, or fiber drums heavily contaminated with parathion shall be incinerated with adequate precautions to prevent inhalation of potentially toxic fumes, vapors, or combustion products, or the materials shall be taken to a sanitary landfill and properly disposed of.

(7) All empty containers contaminated with parathion that are to be disposed of in a sanitary landfill shall first be decontaminated with a strong alkaline solution, or with an equivalent or superior decontaminating solution, and then punctured before disposal.

(8) Empty metal drums or containers contaminated with parathion that are to be reclaimed shall be decontaminated with a strong alkaline solution or with an equivalent or superior decontaminating solution before shipment. The claimer shall be informed of the parathion contamination.

(9) Whenever it is necessary for an employee to perform maintenance or repair work on parathion-contaminated equipment, such as a vessel, pump, valve, pipe, nozzle, etc, the equipment shall be decontaminated with a strong alkaline solution, or with an equivalent or superior decontaminating solution, before maintenance or repair is undertaken.

(10) Reusable clothing that has been worn during the work period shall be placed in a plastic bag or container and labeled with a suitable warning of possible contamination with parathion.

(f) Other Work Practices

(1) Employees handling parathion concentrates shall work in teams. In addition, regardless of the concentration of the material, all mixers, loaders, flaggers, and applicators must maintain periodic communication with a person capable of summoning emergency aid if needed.

(2) Employees potentially exposed to parathion while spraying shall remain upwind from the spray whenever possible.

(3) No aerial applicator may mix or load pesticides containing parathion in whole or in part, unless closed mixing or loading systems are used. This provision allows an aerial applicator to supervise mixing or loading operations involving open systems.

(4) Materials containing parathion shall not be used when testing mixing, loading, or application equipment for leaks, or when testing for clogged valves, lines, or strainers, or when equipment is calibrated.

(5) Dispersal equipment containing parathion may not be turned on outside the area to be treated. Except in an emergency, jettison or otherwise dumping of parathion from application, mixing, or loading vehicles shall be prohibited unless proper disposal procedures are followed.

(6) Employees piloting agricultural aircraft may not fly through the drift of an application, nor shall they start or continue an application if wind creates a drift hazard to themselves or others, nor shall they spray or dust over waterways, canals, buildings, dwellings, vehicles, or persons, including flaggers.

### **Section 7—Sanitation**

#### **(a) Food Facilities**

Storage, preparation, dispensing (including by vending machines), or eating and drinking of foods or beverages shall be prohibited in areas where parathion is present. Employees may not carry food or beverage while working in these areas because of the risk of contamination. The employer shall provide an area free from parathion contamination in which employees may store lunches and other foodstuffs or tobacco products.

#### **(b) Smoking**

Smoking shall be prohibited in areas where parathion is present. Employees may not carry tobacco products while working in these areas because of the risk of contamination.

### **Section 8—Monitoring and Recordkeeping Requirements**

#### **(a) Environmental Monitoring**

(1) Each employer involved in the manufacture or formulation of parathion shall monitor environmental air levels of parathion at least monthly, except as specified otherwise by a professional industrial hygienist. The initial monthly environmental air sampling shall be completed within 6 months of the effective date of a standard incorporating these recommendations. If monitoring of an employee's exposure to parathion reveals that he is exposed at concentrations in excess of the recommended TWA environmental limit, control measures shall be initiated and the employee shall be notified of his exposure and of the control measures being implemented to correct the situation.

Monitoring shall continue until two consecutive samplings, at least a week apart, indicate that employee exposure no longer exceeds the TWA environmental limit specified in Section 1(a). Monthly monitoring may then be resumed.

(2) Air samples shall be collected in the breathing zone of employees to permit calculation of TWA values for every parathion exposure area.

For each TWA determination, a sufficient number of samples shall be taken to characterize each employee's exposure during each work shift. Variations in work and production schedules shall be considered in deciding when samples are to be collected. The number of representative TWA determinations for an operation or process shall be based on the variations in location and job functions of employees in relation to that operation or process.

#### **(b) Recordkeeping**

(1) Sampling records shall be maintained so that exposure information is available for individual employees. These records shall indicate, in addition to the results of air sampling, the type of personal protective device, if any, in use by each employee at the time of sampling. Each employee shall be allowed to obtain information on his or her own environmental exposure.

(2) Records shall be maintained and shall include sampling and analytical methods, types of respiratory devices used, and TWA airborne concentrations found. In addition, the following records shall be maintained for each employee occupationally exposed to parathion:

(A) Preexposure baseline erythrocyte cholinesterase activity or working baseline cholinesterase activity, whichever is applicable.

(B) All cholinesterase activities measured during employment.

(C) Medical records compiled during employment (including preplacement examinations) in accordance with Section 2(a).

(3) Records required by this section shall be maintained for 5 years after the worker's employment has ended and shall be made available to the designated medical representatives of the Secretary of Health, Education, and Welfare, of the Secretary of Labor, of the employer, and of the employee or former employee.

## II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon which were prepared to meet the need for preventing occupational diseases arising from exposure to parathion. The criteria document fulfills the responsibility of the Secretary of Health, Education, and Welfare, under Section 20(a)(3) of the Occupational Safety and Health Act of 1970 to ". . . develop criteria dealing with toxic materials and harmful physical agents and substances which will describe exposure levels at which no employee will suffer impaired health or functional capacities or diminished life expectancy as a result of his work experience."

The National Institute for Occupational Safety and Health (NIOSH), after a review of data and consultation with others, formalized a system for the development of criteria upon which standards can be established to protect the health of workers from exposure to hazardous chemical and physical agents. Criteria for a recommended standard should enable management and labor to develop better engineering controls resulting in more healthful work environments and mere compliance with the recommended standard should not be used as a final goal.

In evaluating occupational hazards and setting priorities, it was determined that parathion is one of the chemicals of greatest immediate concern. Sporadic cases of occupational and accidental poisoning due to concentrated parathion and parathion and/or metabolite residues on fruits, vegetables, and foliage have been reported. Since the late 1940's, when parathion was introduced in the United States for use as an insecticide, an ever-increasing literature on the compound, its properties, and many aspects of its use has accumulated.

These criteria for a standard for parathion are part of a continuing series of criteria developed by NIOSH. The proposed standard applies only to those processes and operations involving the manufacture, processing, and use of parathion as applicable under the Occupational Safety and Health Act of 1970.

These criteria were developed to ensure that the standard based thereon would (1) protect employees against development of acute and chronic parathion poisoning, (2) be measurable by techniques that are available to industry and governmental agencies, and (3) be attainable with

existing technology. Although an environmental limit is recommended herein, because of the extensive use of parathion in agriculture, emphasis has been placed on proper work practices as a means of minimizing parathion exposure and on the appropriate biologic monitoring and medical surveillance of employees who work with parathion. Also, the recommended standard emphasizes the provision of sanitary facilities and the appraisal of all employees of the hazards of parathion and the importance of proper sanitary and work practices generally.

In addition to the obvious hazards attending exposure to concentrated parathion, more subtle problems are posed by the potential exposure of large numbers of agricultural workers to parathion residues on crops and in the agricultural workplace in general. Numerous documented instances of multiple "picker" poisonings exist but the factors involved in the causation of these incidents are only poorly understood. To protect workers from these hazards, the field reentry concept has been given much consideration during the period 1972-76. Reentry intervals define the time between application of the pesticide and entry of workers for any activity involving extensive contact with the crop. The protection of field workers from the potentially hazardous effects of parathion and parathion-metabolite residues on fruits, vegetables, and foliage through the establishment of safe reentry intervals has been intentionally omitted from this recommended standard because of standards promulgated and enforced by the Environmental Protection Agency (*Federal Register* 39:16888-91, May 10, 1974).

The recommended standard was not designed for the population-at-large and any extrapolation beyond general occupational exposures is not warranted.

The development of the recommended standard for occupational exposure to parathion has revealed deficiencies in the data base in the following areas: (1) epidemiologic studies of workers exposed to parathion for extended periods; (2) chronic animal exposure studies at low levels of parathion with emphasis on CNS effects; (3) animal experiments to determine the carcinogenic, mutagenic, and teratogenic potential of parathion for man; (4) the value of electromyography in assessing the toxic potential of parathion; and (5) improvement of the sampling method for personal

monitoring. A more complete discussion of these and several other gaps is presented in Chapter VII—Research Needs.