

I. RECOMMENDATIONS FOR A DINITRO-ORTHO-CRESOL STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that employee exposure to dinitro-ortho-cresol in the workplace be controlled by adherence to the following sections. The standard is designed to protect the health and provide for the safety of employees for up to a 10-hour workshift, 40-hour workweek, over a working lifetime. Compliance with all sections of the standard should prevent adverse effects of dinitro-ortho-cresol 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. Although the workplace environmental limit is considered a safe level based on current information, it should be regarded as the upper boundary of exposure, and every effort should be made to maintain the exposure at levels as low as is technically feasible. The criteria and standards will be subject to review and revision as necessary.

The criteria and recommendations for dinitro-ortho-cresol, which is referred to as DNOC throughout this document, apply to exposure of employees to any DNOC (C₇H₆N₂O₅) isomer or to any of the salts of DNOC. The 4,6 isomer of DNOC is the most commercially important one. DNOC is used primarily as a blossom-thinning agent on fruit trees and as a fungicide, insecticide, and miticide on fruit trees during the dormant season.

An evaluation of the literature indicates that occupational injury and disease associated with exposure to DNOC are caused primarily by

inhalation of and skin contact with the aerosol form. The recommended environmental limit is based on data that indicate that exposure to DNOC may cause severe increases in the basal metabolic rate (BMR) and central nervous system (CNS) disturbances.

"Occupational exposure" to DNOC, because of systemic effects, absorption through the skin on contact, and possible dermal irritation, is defined as work in any area where DNOC is manufactured, formulated, processed, stored, or otherwise used. The "action level" is defined as one-half the recommended time-weighted average (TWA) environmental limit. Adherence to all provisions of the standard is required if any employee is exposed to airborne DNOC at concentrations above the action level. If any employee is occupationally exposed at concentrations equal to or below the action level, then all sections of the recommended standard except Sections 4(c)(2) and 8(a) shall be complied with because adverse effects can be produced by skin and eye contact. If exposure to other chemicals also occurs, provisions of any applicable standards for the other chemicals shall also apply.

Section 1 - Environmental (Workplace Air)

(a) Concentration

When skin exposure is prevented, occupational exposure to DNOC shall be controlled so that no employee is exposed to DNOC at a concentration greater than 0.2 milligrams per cubic meter (mg/cu m) of air, determined as a time-weighted average (TWA) concentration for up to a 10-hour workshift and 40-hour workweek.

(b) Sampling and Analysis

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

Section 2 - Medical

(a) Medical Examinations

Medical surveillance shall be made available as outlined below to all employees subject to occupational exposure to DNOC.

(1) Preplacement examinations shall include at least:

(A) Comprehensive medical and work histories with special emphasis directed to any preexisting disorders, particularly of the lungs, liver, kidneys, thyroid gland, nervous and cardiovascular systems, skin, and eyes.

(B) A physical examination giving special attention to the lungs, liver, kidneys, nervous and cardiovascular systems, skin, and eyes.

(C) A urinalysis that includes a microscopic examination. Additional tests, such as a complete blood count, hematocrit, and liver and kidney function tests, should be considered by the responsible physician.

(D) An evaluation of the worker's ability to use positive and negative pressure respirators.

(2) Periodic examinations shall be made available on at least an annual basis. These examinations shall include at least:

(A) Interim medical and work histories.

(B) A physical examination as described in (1)(B) and (C) of this section.

(C) Clinical tests including at least those described above for the preplacement examination.

(3) Employees displaying signs or symptoms that may be associated with a generalized increase in metabolic rate shall be medically evaluated.

(4) Initial medical examinations shall be made available to all workers as soon as practicable after promulgation of a standard based on these recommendations.

(5) Employees and potential employees having medical conditions, such as disorders of the cardiovascular and respiratory systems, that would be directly or indirectly aggravated by exposure to DNOC shall be counseled on the increased risk of impairment of their health from working with these substances. All employees occupationally exposed to DNOC shall be informed about the value of periodic medical examinations.

(6) In an emergency involving DNOC, such as an employee's clothing becoming wetted with DNOC solution, or if an employee exhibits an array of signs and symptoms consistent with possible DNOC intoxication, affected personnel shall be given immediate first aid, followed by prompt medical evaluation and care. In the event of skin or eye contact with liquid DNOC, contaminated clothing and shoes shall be removed immediately, and skin and eyes shall be flushed with copious amounts of water. In all cases of splashes, spills, or leaks where significant skin or eye contact with or inhalation of the materials occurs appropriate medical personnel

shall be notified. Medical attendants shall be informed of the possibility of systemic effects, and the persons so exposed shall be observed for a minimum of 72 hours. Medical examinations should be made available as warranted by the results of the 72-hour observation period.

(7) Pertinent medical records, including biologic monitoring data, shall be maintained by the employer for all employees occupationally exposed to DNOC. Such records shall be retained for at least 30 years after termination of employment. Records of environmental exposures applicable to an employee shall be included in the employee's medical records 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.

(b) Biologic Monitoring

(1) Biologic monitoring shall be provided to all employees engaged in the following agriculturally related occupations: mixers, loaders, ground and aerial applicators, and flaggers. This monitoring shall consist of weekly sampling and analysis of workers' blood for DNOC content during the period of expected exposure. Measurements shall be taken as close as feasible to, but no sooner than, 8 hours after the weekly exposure ends. Such monitoring shall be performed to ensure that no worker absorbs an unacceptable amount of the compound. Unacceptable absorption of DNOC, indicating a failure of control procedures or work practices, is demonstrated when the DNOC concentration equals or exceeds 20 $\mu\text{g/g}$ of whole blood. Any employee whose blood DNOC concentration exceeds 10 $\mu\text{g/g}$ of whole blood, the "warning" level, 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 potential for dermal exposure. Based on the results of this survey, necessary corrective action shall be taken. Any employee whose whole blood DNOC concentration equals or exceeds 20 $\mu\text{g/g}$ shall be removed from potential exposure to DNOC and placed under medical observation (see paragraph (2) below). In such cases, provisions for an industrial hygiene survey and decisions for possible corrective action shall be as previously prescribed for DNOC concentrations of 10 $\mu\text{g/g}$ of whole blood.

(2) An employee who has been removed from DNOC exposure shall not be allowed to return to work involving occupational DNOC exposure until the concentration of DNOC in the blood is less than 20 $\mu\text{g/g}$, unless the responsible physician has approved the employee's return.

(3) Procedures for collection and analysis of whole blood for DNOC 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

All labels and warning signs shall be printed both in English and in the predominant language of non-English-reading workers. Illiterate workers and workers reading languages other than those used on labels and posted signs shall receive information regarding hazardous areas and shall be informed of the instructions printed on labels and signs.

(a) Labeling

All bulk containers that hold DNOC shall carry, in a readily visible location, a label that bears the trade name of the product and information on the effects of exposure to the compound on human health. The information shall be arranged as in the example below.

DINITRO-ORTHO-CRESOL
(Trade Name)

DANGER!

MAY BE FATAL IF INHALED,
ABSORBED THROUGH SKIN,
OR INGESTED

Avoid breathing vapor or aerosol.
Do not get on skin, in eyes or mouth, or on clothing.
Keep containers closed when not in use.
Use only with adequate ventilation.

First Aid: Call a physician immediately. In case of skin or eye contact, immediately remove contaminated clothing and flush skin or eyes with large amounts of water for at least 15 minutes. If material is inhaled, remove victim to fresh air. If victim is not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, induce vomiting.

NOTE TO PHYSICIAN: Compound is a metabolic stimulant. Treat symptomatically.

(b) Posting

In all manufacturing, formulating, and storage areas where occupational exposure to DNOC can occur, signs containing health hazard warning statements appropriate for DNOC shall be posted in readily visible locations. This information shall be arranged as in the example below.

DANGER!

DINITRO-ORTHO-CRESOL PRESENT IN AREA

MAY BE FATAL IF ABSORBED THROUGH
SKIN, INHALED, OR INGESTED

Avoid breathing vapor or aerosol.
Do not get on skin, in eyes or mouth, or on clothing.

(c) If respirators are required, the following statement shall be added in large letters to the signs required in Section 3(b):

RESPIRATORY PROTECTION REQUIRED IN THIS AREA

(d) In any area where there is a likelihood of emergency situations arising, signs required by Section 3(b) shall be supplemented with signs giving emergency and first-aid instructions and procedures, the location of first-aid supplies and emergency equipment, and the locations of emergency showers and eyewash fountains.

Section 4 - Personal Protective Equipment

Engineering controls and safe work practices shall be used when needed to keep concentrations of airborne DNOC at or below the prescribed limit and to minimize skin and eye contact with DNOC. In addition, employers shall provide protective equipment and clothing to employees when necessary.

(a) Eye Protection

Safety glasses, chemical safety goggles, or face shields (8-inch minimum) with goggles shall be provided by the employer and shall be worn during any operation in which DNOC may contact the eyes (29 CFR 1910.133).

(b) Skin Protection

(1) Unless separately provided in this section, any employees who engage in filling, pouring, mixing, formulating, loading, applying, or otherwise handling DNOC (including open-system manufacturing processes) shall be provided with protective head coverings, face shields (8-inch minimum) with goggles, gloves, full-body coveralls, aprons, rainsuits, and footwear, and these shall be worn when needed to prevent skin contact with DNOC. Gloves should have reverse gauntlets and coveralls should be made of a closely-woven material (nylon or cotton fabric is especially protective).

(2) Employees handling sealed containers of DNOC shall be provided with and required to wear full-body coveralls and gloves.

(3) Employees applying DNOC by closed-cockpit aircraft or by enclosed motor vehicles with air-conditioned cabins shall be provided with gloves. Employees applying DNOC by open-cockpit aircraft shall be provided with and required to wear full-body coveralls, safety goggles, and gloves, and to carry a portable emergency eyewash bottle.

(4) Employees acting as flaggers (other than those flagging from enclosures) in the aerial application of DNOC shall be provided with and required to wear full-body coveralls or rainsuits, protective head and neck coverings, gloves, safety goggles, and footwear.

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

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

(7) Clothing contaminated with DNOC shall be either disposed of or cleaned before reuse. Anyone handling contaminated clothing or responsible for its cleaning shall be instructed as to the hazards, relevant symptoms of overexposure, appropriate emergency procedures, and proper conditions and precautions for the safe handling and use of DNOC.

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

(c) Respiratory Protection

(1) The use of respirators to achieve compliance with the recommended exposure limit is permitted only:

(A) During the time necessary to install or test the required engineering controls.

(B) During emergencies or during nonroutine operations, such as maintenance or repair activities, when air concentrations of DNOC may exceed the permissible environmental limit.

(2) When use of a respirator is permitted, it shall be selected and used pursuant to the following requirements:

(A) The employer shall establish and enforce a respiratory protective program meeting the requirements of 29 CFR 1910.134.

(B) The employer shall provide respirators in accordance with Table I-1 and shall ensure that the employee uses the respirator provided when necessary. The respiratory protective devices provided in conformance with Table I-1 shall comply with the standards jointly approved by NIOSH and the Mining Enforcement and Safety Administration (MESA) as specified under the provisions of 30 CFR 11.

(C) Respirators specified for use in high concentrations of DNOC may be used in atmospheres of lower concentrations.

(D) The employer shall ensure that respirators are adequately cleaned and maintained and that employees are trained and drilled at least annually in the proper use and testing for leakage of respirators assigned to them.

(E) Respirators shall be easily accessible, and employees shall be informed of their location.

Section 5 - Informing Employees of Hazards

(a) Employees working in an area that may involve occupational exposure to DNOC shall be verbally informed of the hazards of such employment, the symptoms associated with exposure to this substance, the appropriate emergency procedures to use, and the proper procedures for the safe handling and use of DNOC.

TABLE I-1

RESPIRATOR SELECTION GUIDE
FOR DNOC MANUFACTURERS, FORMULATORS, AND FIELD WORKERS

Concentration	Respirator Type Approved under Provisions of 30 CFR 11
Equal to or less than 5 mg/cu m	<ul style="list-style-type: none"> (1) Full facepiece respirator equipped with a combination organic vapor cartridge and high-efficiency filter (2) Powered air-purifying respirator with full facepiece, helmet, or hood, equipped with a combination organic vapor cartridge and high-efficiency filter (3) Supplied-air respirator with full facepiece, hood, or helmet (4) Supplied-air impervious suit (5) Self-contained breathing apparatus with full facepiece, operated in demand (negative pressure) mode
Greater than 5 mg/cu m	<ul style="list-style-type: none"> (1) Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive pressure mode (2) Combination Type C supplied-air respirator with full facepiece and auxiliary self-contained air supply, operated in pressure-demand mode
<u>Emergency</u> (entry into area of unknown concentration)	<ul style="list-style-type: none"> (1) Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive pressure mode (2) Combination Type C supplied-air respirator with full facepiece and auxiliary self-contained air supply, operated in pressure-demand mode
Firefighting	Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive pressure mode

(b) A continuing education program, conducted on at least a yearly basis by qualified health and safety personnel, shall be instituted to ensure that employees whose jobs may involve exposure to DNOC, including those engaged in maintenance and repair, are given current knowledge of job hazards, proper maintenance procedures, and cleanup methods. Employees shall be informed of the general nature of the medical surveillance procedures and why it is advantageous to the workers to undergo these examinations. Each employee shall be told about the availability of the required information, which shall include, as a minimum, that prescribed in paragraph (c) of this section.

(c) Required information shall be recorded on the "Material Safety Data Sheet" shown in Appendix IV or on a similar form approved by the Occupational Safety and Health Administration, US Department of Labor, and shall be kept on file, readily accessible to employees.

Section 6 - Work Practices

Protective clothing and equipment, as set forth in Section 4, shall be worn by all employees engaged in any operation where DNOC may come into contact with the skin or eyes.

(a) Work Practices for Manufacture and Formulation of DNOC

(1) Engineering controls, such as process enclosure or local exhaust ventilation, shall be used as needed to keep airborne concentrations of DNOC within the recommended environmental limit. All such control equipment shall meet the requirements of subpart (s) of 29 CFR 1910 for hazardous vocations.

(2) Equipment and systems used for handling and transferring DNOC shall be enclosed to the extent feasible to prevent skin and eye contact.

(3) Containers of DNOC shall be kept tightly closed at all times when not in use. Storage shall be in well-ventilated areas away from heat and strong oxidizers. Containers shall be periodically inspected for leakage and deterioration.

(4) Written operating instructions and first-aid procedures shall be formulated and posted in areas where DNOC is manufactured, formulated, processed, stored, or otherwise used.

(5) All equipment and systems used for handling and transferring DNOC shall be inspected periodically for leaks. Valves, fittings, and connections shall be checked for tightness and good working order. Needed repairs and adjustments shall be made promptly.

(6) Before maintenance work is started, sources of DNOC shall be eliminated to the extent feasible. If airborne concentrations exceed the recommended environmental limit, respiratory protective equipment as described in Table I-1 shall be required during such maintenance work.

(7) Easily accessible, well-marked emergency showers and eyewash fountains shall be available in all work areas where DNOC is manufactured or formulated. In case of contact, the skin or eyes shall be flushed with large amounts of water for at least 15 minutes.

(8) Clothing that has become contaminated shall be either cleaned before reuse or disposed of. Contaminated clothing shall be kept in properly labeled, closed containers until it is laundered or discarded.

(9) Facilities, such as double lockers, shall be provided for each employee so clean and soiled clothing can be kept separate.

(10) Transportation and use of DNOC shall comply with all federal, state, and local regulations.

(b) Work Practices in the Application of DNOC

(1) Employees handling DNOC 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 DNOC while spraying shall remain upwind from the spray whenever possible.

(3) No aerial applicator may mix or load pesticides containing DNOC 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 DNOC 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 DNOC may not be turned on outside the area to be treated. Except in an emergency, jettison or otherwise dumping of DNOC 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.

(7) Employees occupationally exposed to DNOC shall have provided to them in a readily accessible site either 25 gallons of water for each person or 100 gallons, whichever is greater. Motor vehicles shall have at least 20 gallons of water stored in closed containers. Agricultural aircraft shall carry emergency eyewash bottles.

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

(c) Control of Unit Operations

(1) Controls of unit operations of equivalent or superior effectiveness may be substituted for those specified in paragraphs 2 through 9 below.

(2) All fittings, hoses, tubing, pumps, valves, and associated equipment operated at positive pressure shall be sufficient to withstand 2.5 times the maximum pressure and tested at least weekly for leaks and other signs of deterioration.

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

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

(5) 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 to prevent rupture of hoses, pipes, tubing, or pumps.

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

(7) Opaque tanks used for mixing, loading, or applying DNOC shall be equipped with indicators of the level of liquid within the tank.

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

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

(d) Emergency Procedures

Emergency plans and procedures shall be developed for all work areas where there is a potential for exposure to DNOC. The measures shall include those specified below and any others considered appropriate for a specific operation or process. Employees shall be trained to implement the plans and procedures effectively.

(1) Prearranged plans shall be instituted for obtaining emergency medical care and for the transportation of injured workers. A sufficient number of employees shall be trained in first aid so that assistance is available immediately when necessary.

(2) Spills of DNOC shall be cleaned up immediately. The area of the spill shall be posted and secured. Only authorized personnel,

adequately protected and properly trained, shall be permitted to enter the area to shut off sources of DNOC.

(3) Spilled liquids shall be sorbed with vermiculite, dry sand, earth, or other appropriate material. If sufficient drainage to suitable collection basins is available, spilled liquid shall be hosed away with large quantities of water. Methods of waste disposal shall comply with applicable federal, state, and local regulations.

(e) Confined Spaces

(1) Cleaning, maintenance, and repair of tanks, process equipment, and lines shall be done only by properly trained and adequately protected employees under supervisory control.

(2) Entry into confined spaces, such as tanks, pits, tank cars, barges, and process vessels, shall be controlled by a permit system. Permits shall be signed by an authorized representative of the employer and shall certify that preparation of the confined space, precautionary measures, and personal protective equipment are adequate and that precautions have been taken to ensure that prescribed procedures will be followed.

(3) Before they are entered, confined spaces shall be inspected and tested for oxygen deficiency and for the presence of DNOC and other known or suspected contaminants.

(4) No employee shall enter any confined space that does not have an entry large enough to admit an employee equipped with safety harness, lifeline, and appropriate respiratory equipment.

(5) Personnel entering confined spaces shall wear respirators as specified in Section 4.

(6) Confined spaces shall be ventilated while work is in progress to keep the concentration of airborne DNOC and any other contaminants at or below their recommended environmental limits and to prevent oxygen deficiency.

(7) Anyone entering a confined space shall be observed from the outside by another properly trained and protected worker. An additional supplied-air or self-contained breathing apparatus with safety harness and lifeline shall be located outside the confined space for emergency use. The person entering the confined space shall maintain continuous communication with the standby worker.

Section 7 - Sanitation

(a) Plant sanitation shall meet the requirements of 29 CFR 1910.141.

(b) Food preparation, dispensing (including vending machines), and eating shall be prohibited in areas where DNOC is manufactured, formulated, processed, stored, or otherwise used.

(c) Smoking shall be prohibited in areas where DNOC is manufactured, formulated, processed, stored, or otherwise used.

(d) Employees who handle DNOC shall be instructed to wash their hands thoroughly with soap or mild detergent and water before using toilet facilities or eating.

Section 8 - Monitoring and Recordkeeping Requirements

As soon as practicable after the promulgation of a standard based on these recommendations, employers shall determine by an industrial hygiene survey whether exposure to airborne DNOC is in excess of the action level. Records of these surveys shall be kept, and if an employer concludes that air levels are at or below the action level, the records must show the basis for this conclusion. Surveys shall be repeated at least once every year and within 30 days of any process change likely to result in an increased concentration of airborne DNOC. When the industrial hygiene survey demonstrates that the environmental concentration of DNOC exceeds the action level, the following requirements shall apply:

(a) Personal Monitoring

(1) A program of personal monitoring shall be instituted to identify and measure, or to permit calculation of, the exposure of each employee occupationally exposed to airborne DNOC. Source and area monitoring may be used to supplement personal monitoring.

(2) In all personal monitoring, samples representative of the exposure to airborne DNOC in the breathing zone of the employee shall be collected. Procedures for sampling and analysis of DNOC shall be in accordance with Section 1(b).

(3) For each TWA concentration determination, a sufficient number of samples shall be taken to characterize employee exposures during each workshift. Variations in work and production schedules, as well as employee locations and job functions, shall be considered in decisions on sampling locations, times, and frequencies.

(4) Each operation shall be sampled at least once every 3

months or as otherwise indicated by a professional industrial hygienist. If an employee is found to be exposed at a level in excess of the TWA concentration limit, the exposure of that employee shall be measured at least once every week, control measures shall be initiated, and the employee shall be notified of the exposure and of the control measures being implemented. Such monitoring shall continue until two consecutive determinations, at least 1 week apart, indicate that employee exposure no longer exceeds the environmental limit. Quarterly monitoring shall then be resumed.

(b) Recordkeeping

Records of environmental monitoring shall be kept for at least 30 years. These records shall include the dates and times of measurements, duties and location of the employees within the worksite, sampling and analytical methods used, number, duration, and results of the samples taken, TWA concentrations estimated from these samples, type of personal protective equipment used, if any, and employees' names. These records shall be made available to the designated representatives of the Secretary of Labor, of the Secretary of Health, Education, and Welfare, 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 disease or injury arising from exposure to DNOC. 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, has formalized a system for the development of criteria upon which standards can be established to protect the health and to provide for the safety of employees exposed to hazardous chemical and physical agents. The criteria and recommended standards should enable management and labor to develop better engineering controls resulting in more healthful work environments, and mere compliance with the recommended standards should not be regarded as a final goal.

The criteria and recommended standard for DNOC are part of a continuing series of documents published by NIOSH. The proposed standard applies to the manufacture, formulation, processing, storage, and use of, or other occupational exposure, to DNOC as applicable under the Occupational Safety and Health Act of 1970. The standard was not designed for the population-at-large, and any extrapolation beyond the occupational

environment is not warranted. It is intended to protect against the development of systemic toxic effects and local effects on the skin and eyes of employees and be measurable by techniques that are valid, reproducible, and available to industry and governmental agencies.

Occupational exposure to DNOC in the United States occurs primarily to employees involved in the formulation or spraying of DNOC products for agricultural use. Inhalation of the aerosol or vapor is the most common route of occupational exposure, and the subsequent severe stimulation of metabolism and possible effects on the CNS are major reasons for concern about employee exposure to DNOC. Although there is considerable information on the health effects of inhaled DNOC, the concentrations at which it causes intoxication in humans have been investigated in only a few studies, and these studies have inadequately described the health effects. Therefore, further research is needed to elucidate the effects in humans of both short- and long-term exposure to airborne DNOC at concentrations at or below the recommended environmental limit. Since there is evidence that blood DNOC levels are correlated with toxic signs and symptoms, it would be desirable to obtain additional information on the relationship between the concentration of DNOC a person is exposed to and the resultant blood DNOC levels. Experiments to assess the carcinogenic, mutagenic, and teratogenic potential of DNOC are also needed.