
NIOSH

CRITERIA FOR A
RECOMMENDED STANDARD...

OCCUPATIONAL
EXPOSURE TO

NITRILES

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

criteria for a recommended standard. . .

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September 1978

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DHEW (NIOSH) Publication No. 78-212

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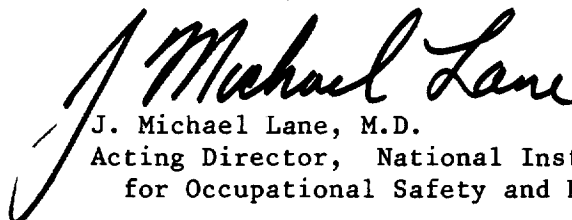
PREFACE

The Occupational Safety and Health Act of 1970 emphasizes the need for standards to protect the health and provide for the safety of workers occupationally exposed to an ever-increasing number of potential hazards. The National Institute for Occupational Safety and Health (NIOSH) evaluates all available research data and criteria and recommends standards for occupational exposure. The Secretary of Labor will weigh these recommendations along with other considerations, such as feasibility and means of implementation, in promulgating regulatory standards.

NIOSH will periodically review the recommended standards to ensure continuing protection of workers and will make successive reports as new research and epidemiologic studies are completed and as sampling and analytical methods are developed.

The contributions to this document on nitriles by NIOSH staff, other Federal agencies or departments, the review consultants, the reviewers selected by the Society of Toxicology, and Robert B. O'Connor, M.D., NIOSH consultant in occupational medicine, are gratefully acknowledged.

The views and conclusions expressed in this document, together with the recommendations for a standard, are those of NIOSH. They are not necessarily those of the consultants, the reviewers selected by professional societies, or other Federal agencies. However, all comments, whether or not incorporated, were considered carefully and were sent with the criteria document to the Occupational Safety and Health Administration for consideration in setting the standard. The review consultants and the Federal agencies which received the document for review appear on pages v and vi.


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The Division of Criteria Documentation and Standards Development, National Institute for Occupational Safety and Health (NIOSH), had primary responsibility for the development of the criteria and recommended standard for nitriles. Sonia Berg of this Division served as criteria manager. Equitable Environmental Health, Inc. (EEH) developed the basic information for consideration by NIOSH staff and consultants under contract CDC 210-77-0148.

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I. RECOMMENDATIONS FOR A NITRILES STANDARD

NIOSH recommends that employee exposure to selected aliphatic saturated nitriles in the workplace be controlled by adherence to the following sections. The recommended 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 recommended standard should prevent adverse effects of exposure on the health and safety of workers. Although NIOSH considers the recommended workplace environmental limits to be safe based on current information, the employer should regard them as the upper boundaries of exposure and make every effort to maintain any exposure as low as is technically feasible. These criteria and recommended standard will be reviewed and revised as necessary.

Nitriles are defined as organic compounds that contain a cyano group, $C\equiv N$, as the characteristic functional group. They may react to release cyanide. Ten nitriles are included in the recommended standard, namely, the mononitriles (acetonitrile, propionitrile, n-butyronitrile, and isobutyronitrile); the cyanohydrins (glycolonitrile and acetone cyanohydrin); and the dinitriles (malononitrile, succinonitrile, adiponitrile, and tetramethylsuccinonitrile). Their selection was based on the extent of production and use in industry and the degree of toxicologic hazard, but acrylonitrile was omitted because NIOSH recently recommended an Emergency Temporary Standard for the chemical. The term "selected nitriles" will be used to refer to these compounds. "Occupational exposure" to selected nitriles is defined as exposure to airborne concentrations at or above the action level. "Action level" is defined as one-half the time-weighted average (TWA) or ceiling workplace environmental limit, whichever is appropriate. The criteria and recommended standards apply to any area in which nitriles are produced, packaged, processed, mixed, blended, handled, or stored. If concomitant exposure to other chemicals occurs during the production and use of the selected nitriles, the employer shall comply also with the provisions of applicable standards for these other chemicals. Adherence to all provisions of the recommended standard is required if any employee is exposed to airborne nitriles 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 Section 8(a) shall be complied with because adverse effects can be produced by skin and eye contact with nitriles.

The recommended standard is based on reports indicating that the selected nitriles are sources of cyanide ion, which interferes with basic cellular oxidative mechanisms, and that they have effects on the cardiovascular, renal, gastrointestinal, hepatic, and central nervous

systems. These nitriles exert their toxic actions after inhalation, dermal contact, or ingestion. Dinitriles, and possibly other nitriles, irritate the eyes, skin, and upper and lower respiratory tract. No carcinogenic, mutagenic, teratogenic, or reproductive effects in humans have been reported. However, acrylonitrile (vinyl cyanide) has been found to be carcinogenic in animal tests, and the recent NIOSH recommendation for an Emergency Temporary Standard was based on the serious suspicion that acrylonitrile may be a human carcinogen. The carcinogenicity of this compound may be associated with the vinyl component rather than with its identity as a nitrile. Compliance with the recommended standard should eliminate the hazards associated with the selected nitriles.

Section 1 - Environmental (Workplace Air)

(a) Concentration

Workplace exposure to nitriles shall be controlled so that employees are not exposed at concentrations greater than the limits, in milligrams per cubic meter (mg/cu m) of air, shown in Table I-1 as either TWA concentrations for up to a 10-hour workshift, 40-hour workweek, or as ceiling concentrations based on a 15-minute sampling period.

When there is simultaneous exposure to several nitriles or other sources of cyanide, the exposures shall be regarded as additive, and the environmental concentration limit for equivalent exposure to a mixture (E_m) shall be determined as follows:

$$E_m = C_1/L_1 + \dots + C_n/L_n$$

where:

C_1 = the concentration of the main component of the mixture

C_n = the concentration of other constituents of the mixture,
with n having values from 2 to n

L_1 = the permissible exposure limit for the main component

L_n = the permissible exposure limits for other constituents,
with n having values from 2 to n

E_m shall not exceed 1.

Compounds with ceiling concentration limits are additive independently from those that have TWA exposure limits. When the additive formula exceeds 1, exposure to the mixture shall be reduced even if none of the individual TWA or ceiling concentration limits is exceeded.

TABLE I-1
RECOMMENDED WORKPLACE EXPOSURE LIMITS

Nitrile	mg/cu m	Approximate ppm Equivalents	Type of Limit
Acetonitrile	34	20	TWA
Propionitrile	14	6	"
n-Butyronitrile	22	8	"
Isobutyronitrile	22	8	"
Acetone cyanohydrin	4	1	Ceiling
Glycolonitrile	5	2	"
Malononitrile	8	3	TWA
Adiponitrile	18	4	"
Succinonitrile	20	6	"
Tetramethyl- succinonitrile	6	1	Ceiling

(b) Sampling and Analysis

Workplace air samples shall be collected and analyzed for nitriles as described in Appendix I or by any method shown to be at least equivalent in accuracy, precision, and sensitivity.

Section 2 - Medical

Medical surveillance shall be made available as specified below to all employees subject to exposure to the compounds covered by this standard.

(a) Preplacement medical examinations shall include at least:

(1) Comprehensive medical and work histories, with special emphasis directed to skin disorders and the cardiopulmonary and central nervous systems.

(2) A physical examination giving particular attention to the skin and the cardiovascular, pulmonary, and central nervous systems.

(3) Specific clinical tests including a 14- x 17-inch chest X-ray and tests of pulmonary function such as the forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV_1).

(4) An evaluation of the employee's physical ability to safely wear a positive pressure respirator. Factors such as age, evidence of obstructive lung disease or impairment, cardiopulmonary impairment, and level of activity required while wearing the device should be considered in evaluating the worker's ability to wear respirators.

(b) Periodic examinations shall be made available at least annually and shall consist of the following:

(1) Interim medical and work histories.

(2) Physical examination as described in (a)(2) and (3) above, with the exception of an annual chest X-ray.

(c) In view of the numerous body systems in which toxic effects of nitriles have been demonstrated, medical and work histories and physical examinations should be thorough and should give particular attention to combinations of signs or symptoms, including evidence of dermal contact, which may indicate toxicity.

(d) Employees with evidence of impaired pulmonary function or cardiovascular disease shall be counseled as to the possible increased risk of impairment to their health from working with selected nitriles.

(e) A responsible physician and the employer shall be aware of first-aid and treatment procedures and shall ensure that trained employees are on duty whenever there is a potential occupational exposure to these selected nitriles or their decomposition product, hydrogen cyanide.

(f) In addition to medical treatment kits, as described in Appendix III, first-aid kits shall be immediately available at workplaces where there is potential exposure to nitriles. Kits shall contain as a minimum two boxes of ampules (two dozen), each containing 0.3 ml of amyl nitrite. Ampules shall be replaced as often as necessary to ensure their potency.

The amyl nitrite ampules should be protected from high temperatures. In all cases, the contents of the first-aid kits shall be replaced before the manufacturer's assigned expiration dates.

(g) Pertinent medical records shall be kept for 30 years after employment has ended for all employees exposed to the selected nitrile in the workplace. Records of environmental exposures for an employee shall be included in the employee's medical records. These records 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.

Section 3 - Labeling and Posting

(a) Containers of nitriles used or stored in the workplace shall carry a label, in a readily visible location, that bears the chemical name of the nitrile contained therein, the trade name of the product, and information on the effects of the particular compound on human health. The trade name and/or other designation and other pertinent information shall be arranged as in the following example:

MALONONITRILE
(TRADE NAME OR OTHER DESIGNATION)

MAY BE HARMFUL IF INHALED, SWALLOWED,
OR ABSORBED THROUGH SKIN

IRRITATING TO SKIN AND EYES

Avoid contact with eyes, skin, and clothing.
Avoid inhaling vapor, aerosol, fumes, gases.
Use only with adequate ventilation.

First Aid: Remove victims to fresh air immediately. Apply artificial respiration if breathing stops. Wash exposed skin or eyes thoroughly with water and remove contaminated clothing and shoes. If material has been swallowed and the victim is conscious, induce vomiting. If the victim is unconscious but still breathing, administer vapor of amyl nitrite under the victim's nose for 15 seconds. Repeat five times at about 15-second intervals. Consult a physician as soon as possible.

(b) Posting

In areas where nitriles are used, signs containing information on the effects of the specific compounds on human health shall be posted in

readily visible locations. This information shall be arranged as in the following example:

MALONONITRILE
(TRADE NAME OR OTHER DESIGNATION)

MAY BE HARMFUL IF INHALED, SWALLOWED,
OR ABSORBED THROUGH SKIN

IRRITATING TO SKIN AND EYES

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

RESPIRATORY PROTECTION REQUIRED IN THIS AREA

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

(e) All warning signs shall be printed in English and in the predominant language of non-English-reading employees. Employers shall ensure that employees unable to understand these signs and labels also know the hazards associated with the selected nitriles and the location of areas in which there may be occupational exposures.

Section 4 - Personal Protective Equipment and Clothing

Engineering controls and safe work practices shall be used when needed to keep the concentration of airborne nitriles at or below the limits specified in Section 1(a). Protective clothing and equipment shall be provided by the employer and worn by the employee to prevent skin and eye contact with nitriles, particularly in the liquid form. Emergency equipment shall be located at clearly identified stations within the work area and shall be adequate to permit all employees to escape safely from the area. Protective equipment suitable for emergency use shall be located at clearly identified stations outside the work area.

(a) Protective Clothing

(1) The employer shall provide chemical safety goggles or face shields (20-cm or 8-inch minimum) and goggles, and shall ensure that

employees wear the protective equipment during any operation where eye contact with liquid nitriles is likely.

(2) The employer shall provide appropriate protective clothing made of material resistant to penetration by nitriles, including gloves, aprons, coveralls, and boots, and shall ensure that employees wear protective clothing when necessary to prevent skin contact. The employer shall ensure that personal protective clothing is regularly inspected for defects.

(b) Respiratory Protection

(1) Engineering controls shall be used whenever needed to maintain nitrile concentrations at or below the recommended workplace limits. The use of respiratory protective equipment is permitted only in the following circumstances:

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

(B) For operations such as maintenance and repair activities causing brief exposure at concentrations in excess of the recommended environmental limits.

(C) During sampling of process streams.

(D) During emergencies when concentrations of airborne nitriles might exceed the recommended environmental limits.

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

(B) The employer shall ensure that employees are properly instructed in the use of respirators assigned to them and in how to test for leakage, proper fit, and proper operation as judged by quantitative fit tests. Quantitative face seal fit test procedures using sodium chloride, dioctyl phthalate, or the equivalent shall be used. For full-facepiece cartridge respirators, the maximum allowable leakage is 2% of the test atmosphere.

(C) The employer shall provide respirators in accordance with Tables I-2 and I-3, and shall ensure that employees use the respirators properly when they are required. The respiratory protective devices shall be approved by NIOSH and the Mine Safety and Health Administration (MSHA) as specified under the provisions of 30 CFR 11.

(D) Respirators specified for use in higher concentrations of a specific airborne nitrile may be used in atmospheres of lower concentrations.

(E) When a self-contained breathing apparatus is permitted in accordance with these tables, it shall be used pursuant to the following requirements:

(i) The employer shall provide initial training and refresher courses on the use, maintenance, and function of a self-contained breathing apparatus.

(ii) Whenever a self-contained breathing apparatus is supplied for escape purposes, the respirator shall be operated in the pressure-demand or continuous-flow mode.

TABLE I-2

RESPIRATOR SELECTION GUIDE FOR ACETONITRILE,
N-BUTYRONITRILE, ISOBUTYRONITRILE, AND PROPIONITRILE

Concentration	Respirator Type Approved under Provisions of 30 CFR 11
Less than or equal to 100 ppm	(1) Chemical cartridge respirator with full facepiece and organic vapor cartridge (2) Supplied-air respirator with a full facepiece, helmet, or hood, operated in demand mode
Less than or equal to 1,000 ppm	(1) Supplied-air respirator with a full facepiece, helmet, or hood, operated in pressure-demand or continuous-flow mode (2) Self-contained breathing apparatus with a full facepiece operated in pressure-demand mode
Greater than 1,000 ppm or emergency (entry into area of unknown concentration)	(1) Self-contained breathing apparatus with a full facepiece operated in pressure-demand mode (2) Supplied-air respirator with a full facepiece, helmet, or hood, operated in pressure-demand or continuous-flow mode, with auxiliary self-contained breathing apparatus

TABLE I-3

RESPIRATOR SELECTION GUIDE FOR ACETONE CYANOHYDRIN,
 GLYCOLONITRILE, MALONONITRILE, SUCCINONITRILE,
 ADIPONITRILE, AND TETRAMETHYLSUCCINONITRILE

Concentration	Respirator Type Approved under Provisions of 30 CFR 11
Less than or equal to 50 ppm	(1) Supplied-air respirator with a full facepiece, helmet, or hood, operated in demand mode (2) Self-contained breathing apparatus with a full facepiece operated in demand mode
Less than or equal to 250 ppm	(1) Supplied-air respirator with a full facepiece, helmet, or hood, operated in pressure-demand or continuous-flow mode (2) Self-contained breathing apparatus with a full facepiece operated in pressure-demand mode
Greater than 250 ppm or emergency (entry into area of unknown concentration)	(1) Self-contained breathing apparatus with a full facepiece operated in pressure-demand mode (2) Supplied-air respirator with a full facepiece, helmet, or hood, operated in pressure-demand or continuous-flow mode, with auxiliary self-contained breathing apparatus

Section 5 - Informing Employees of Hazards from Nitriles

(a) The employer shall provide information at the beginning of employment and on a semiannual basis thereafter on the hazards, relevant symptoms, appropriate emergency procedures, and proper conditions and precautions for the safe handling or use of the selected nitriles to all employees working in the areas where exposure may occur. First-aid procedures shall be included. This information shall be readily available to all employees involved in the manufacture, use, transport, or storage of selected nitriles and shall be posted in prominent positions within the workplace.

(b) The employer shall institute a continuing education program, conducted by persons qualified by experience and training, to ensure that all employees have current knowledge of job hazards, proper maintenance and

cleanup methods, and proper respirator usage and maintenance. The instructional program shall include a description of the general nature of the medical surveillance procedures and of the advantages to the employee of undergoing these examinations. As a minimum, instruction shall include the information on the Material Safety Data Sheet (MSDS) in Appendix II.

(c) Required information shall be recorded on the MSDS specified in Appendix II or on a similar form approved by the Occupational Safety and Health Administration, US Department of Labor. The appropriate form shall be readily accessible to employees at all places of employment where exposure may occur.

Section 6 - Work Practices and Control Procedures

(a) Emergency Procedures

Employers shall take all necessary steps to ensure that employees are instructed in and follow the procedures specified below, and any others appropriate for the specific operation or process, for all work areas where there is a potential for emergencies involving nitriles.

(1) Instructions shall include prearranged plans for obtaining emergency medical care and for transporting injured employees.

(2) Eye, skin, and respiratory protection as specified in Section 4 shall be used by personnel engaged in emergency operations. Employees not essential to emergency operations shall be evacuated from hazardous areas where inhalation, ingestion, or direct skin or eye contact may occur. The perimeters of these areas shall be delineated, posted, and secured.

(3) Only personnel properly trained in the procedures and adequately protected against the attendant hazards shall shut off sources of nitriles, clean up spills, and repair leaks. Spills and leaks shall be attended to immediately to minimize the possibility of exposure.

(4) Any large spill of nitriles to be discarded shall be diluted with water, with sufficient alkali added to establish a pH of more than 9.5, and the neutralized spill drained to a chemical sewer system, which should not receive any influx of acids.

(5) Firefighting procedures shall be established for areas where flammable materials are used with nitriles. Chemical foam, dry chemical, carbon dioxide, or water spray shall be used to extinguish fires in areas where nitriles are present. Hydrogen cyanide and other toxic products may be released during a fire, and proper protective respirators and clothing shall be worn by all personnel in the hazard area until concentrations of airborne nitriles and hydrogen cyanide have been shown to be below the recommended concentration limits.

(6) Eyewash fountains and emergency showers shall be provided and readily accessible to employees in all areas where skin or eye contact with nitriles is possible.

(b) Control of Airborne Nitriles

Engineering controls, such as process enclosure and local exhaust ventilation, shall be used whenever needed to keep concentrations of nitriles within the recommended workplace limits. Ventilation systems shall be designed and operated to prevent the accumulation or recirculation of nitriles in the workplace environment and to effectively remove nitriles from the breathing zones of employees. Design of ventilation systems, as well as other equipment, shall conform to requirements for the appropriate flammability class for each nitrile (see Table V-1). Exhaust ventilation systems discharging to outside air shall conform to applicable local, state, and Federal air pollution regulations and shall not constitute a hazard to employees or the general public. Ventilation systems shall be subject to regular preventive maintenance and cleaning to ensure effectiveness, which shall be verified by airflow measurements taken at least every 3 months.

(c) Storage

Containers of nitriles shall be kept tightly closed at all times when not in use. Containers shall be stored in a safe manner to minimize accidental breakage or spillage, to avoid heat, and to prevent contact with acids and strong oxidizers.

(d) Handling and General Work Practices

(1) Before maintenance work is undertaken, sources of nitriles shall be shut off. If concentrations at or below the recommended workplace limits cannot be assured, respiratory protective equipment, as described in Section 4 of this chapter, shall be used during such maintenance work.

(2) In case of contact, the skin or eyes shall be flushed immediately with large amounts of water to remove all traces of nitriles. Contaminated clothing shall be removed immediately and disposed of or cleaned before reuse. Any contaminated clothing shall be stored, transported, or disposed of in a manner that prevents further dispersion of or exposure to nitriles. Personnel involved in cleaning contaminated clothing shall be informed about the hazards and appropriate precautions for the safe handling of these compounds. Contaminated leather shoes shall be discarded.

(3) Entry into confined spaces, such as tanks, pits, process vessels, tank cars, sewers, or tunnels, where there may be limited egress,

shall be controlled by a permit system. Permits shall be signed by an authorized employer representative certifying that preventive and protective measures have been followed.

Confined spaces that have contained nitriles shall be thoroughly ventilated to ensure an adequate supply of oxygen, tested for nitriles and other contaminants, and inspected for compliance with these requirements before each entry. Adequate ventilation shall be maintained while an employee or other individual is in the space. Leakage of nitriles or other contaminants into the confined space while work is in progress shall be prevented by disconnecting and blanking the supply lines for nitriles and other materials. An individual entering a confined space shall be furnished with appropriate personal protective clothing and devices and protected by a lifeline harness tended by another employee outside the space. The employee tending the lifeline shall also be equipped with personal protective clothing and devices approved for entry and shall have contact with a third party. Communication (visual, voice, signal line, telephone, radio, or other suitable means) shall be maintained by the standby person with the employee inside the confined or enclosed space. A third employee, equipped to proceed to the aid of the other two if necessary, shall be in a position to maintain a general surveillance of their activities.

Section 7 - Sanitation

(a) Consuming, preparing, or dispensing of food or beverages (including vending machines) shall be prohibited in nitrile work areas.

(b) Smoking shall not be permitted in areas where nitriles are manufactured, used, transferred, or stored.

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

(d) Clothing that has been contaminated by nitriles shall be discarded or decontaminated by laundering or by an equivalent method.

(e) Waste material contaminated with nitriles shall be disposed of in a manner not hazardous to employees. The disposal method shall conform with applicable local, state, and Federal regulations and shall not constitute a hazard to the surrounding population or environment.

Section 8 - Monitoring and Recordkeeping Requirements

Employers shall conduct an industrial hygiene survey at locations where nitriles are released into workplace air to determine whether exposure to airborne concentrations of nitriles is in excess of the action level. The

employer shall keep records of these surveys. If the employer concludes that concentrations of airborne nitriles are at or below the action level, the records shall show the basis for this conclusion. Surveys shall be repeated at least annually and within 30 days of any process change likely to alter concentrations of any of these compounds in the workplace air. If it has been concluded that the environmental concentration of nitriles exceeds the action level, then the employer shall fulfill the following requirements:

(a) Personal Monitoring

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

(2) Samples representative of the exposure to nitriles in the breathing zone of the employee shall be collected in all personal monitoring. Procedures for the calibration of equipment, sampling, and analysis of nitriles shall be as provided in Section 1(b).

(3) For each TWA concentration determination, a sufficient number of samples shall be taken to characterize the employee's exposure during each workshift. For determination of ceiling concentrations, employees shall be observed along with the operation in process to determine when maximum exposure is expected. A sufficient number of 15-minute samples taken during the time of such maximum exposure shall be used to determine the actual ceiling concentration to which an employee is exposed. Variations in the employee's work schedule, location, and duties and changes in production schedules shall be considered when samples are collected.

(4) If an employee is found to be exposed above the action level but below the recommended environmental limit, the exposure of that employee shall be monitored at least once every 3 months. If an employee is found to be exposed in excess of the recommended environmental 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 recommended environmental concentration limit; quarterly monitoring shall then be resumed.

(b) Recordkeeping

Employers or their successors shall keep records of environmental monitoring for each employee for at least 30 years after the individual's

employment has ended. These records shall include an identification of the employee being monitored, duties and job locations within the worksite, dates of measurements, sampling and analytical methods used and evidence of their accuracy, duration of sampling, number of samples taken, results of analyses, TWA or ceiling concentrations based on these samples, and any personal protective equipment used. Records for each employee, indicating date of employment with the company and any changes in job assignment, shall be kept for the same 30-year duration. The employer shall make these records available upon request to authorized representatives of the Secretary of Labor and of the Secretary of Health, Education, and Welfare. Employees or authorized representatives shall have access to information on their own exposures, and they shall be given the opportunity to observe any measurement conducted in accordance with this section.

II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon that were prepared to meet the need for preventing occupational disease or injury arising from exposure to selected aliphatic saturated nitriles. 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."

After reviewing data and consulting with others, NIOSH formalized a system for the development of criteria on which standards can be established to protect the health and provide for the safety of employees exposed to hazardous chemical and physical agents. Criteria for an environmental standard should enable management and labor to develop better engineering controls and work practices resulting in more healthful work environments; simply complying with the recommended standard should not be regarded as a final goal.

These criteria for a standard for selected aliphatic saturated nitriles are part of a continuing series of documents published by NIOSH. The recommended standard applies to workplace exposure to these selected nitriles resulting from manufacture, storage, handling, and use or release as intermediates, byproducts, or impurities. The standard was not designed for the population-at-large, and any extrapolation beyond the occupational environment is not warranted. It is intended to: (1) protect workers against skin and eye irritation and systemic effects; (2) be measurable by techniques that are available to industry and governmental agencies; and (3) be attainable with existing technology.

The selected nitriles included in this recommended standard are the mononitriles (acetonitrile, propionitrile, n-butyronitrile, and isobutyronitrile), the cyanohydrins (glycolonitrile and acetone cyanohydrin), and the dinitriles (adiponitrile, malononitrile, succinonitrile, and tetramethylsuccinonitrile).

Exposure to these nitriles occurs primarily by the dermal and inhalation routes, but there are also adverse effects from contact of these nitriles with the eyes. Depending on the amount absorbed, nitriles may cause central nervous system (CNS), hepatic, renal, cardiovascular, and gastrointestinal disorders, regardless of route of administration. These effects are attributed to the metabolic release of cyanide but may also be due in part to the intact molecule.

Development of the criteria for the recommended standard for occupational exposure to the selected nitriles indicates a need for further research in several areas, including: (1) comparative animal toxicity studies including exposure to mixtures known to occur in the workplace; (2) further research on sampling and analytical methods needed to characterize exposure; (3) epidemiologic studies to characterize the health effects produced by exposure to these nitriles in the occupational environment; (4) studies on potential carcinogenic, mutagenic, teratogenic, and reproductive effects; (5) studies on the rate of release of cyanide ion from various nitriles in mammalian systems; (6) further studies on reported health effects that may be attributed to the nitrile itself as well as to the release of cyanide; (7) the efficacy of emergency treatment of nitrile poisoning using sodium nitrite and sodium thiosulfate; and (8) the development of an improved analytical method for urinary thiocyanate. A more complete discussion of these research recommendations is presented in Chapter VII.