

NIOSH

**CRITERIA FOR A RECOMMENDED STANDARD....
OCCUPATIONAL EXPOSURE TO**

INORGANIC LEAD Revised Criteria - 1978



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....

**OCCUPATIONAL EXPOSURE
TO
INORGANIC LEAD**

Revised Criteria - 1978



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National Institute for Occupational Safety and Health

May 1978

For sale by the Superintendent of Documents, U.S. Government
Printing Office, Washington, D.C. 20402

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DHEW (NIOSH) Publication No. 78-158

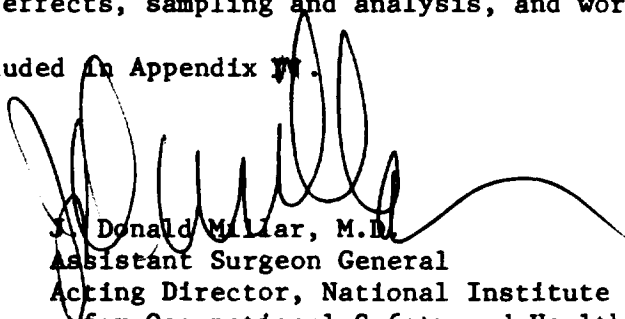
PREFACE TO THE REVISED RECOMMENDED STANDARD

The original criteria document for an Occupational Exposure to Inorganic Lead was published January 5, 1973.

On January 15, 1976, the Occupational Safety and Health Administration published a proposal for a revised occupational health standard for inorganic lead. At the same time NIOSH initiated an evaluation of the scientific literature published since the original document was issued. The Occupational Safety and Health Administration held hearings during the period of July 1-15, 1977, at which NIOSH presented testimony. This revised criteria document is based on the new information gained from the literature evaluation and reflects the NIOSH testimony which is included as Appendix V.

The primary changes in the recommended standard are a lowering of the permissible exposure level from 150 to 100 $\mu\text{g}/\text{m}^3$, lowering of the maximum blood level from 80 to 60 $\mu\text{g}/100\text{ g}$, revised recommendations for respiratory protection, and more up-to-date recommendations regarding work practices and sanitation.

New information on biologic effects, sampling and analysis, and work practices and sanitation are included in Appendix VI.



J. Donald Millar, M.D.
Assistant Surgeon General
Acting Director, National Institute
for Occupational Safety and Health

The Office of Research and Standards Development, National Institute for Occupational Safety and Health, had primary responsibility for development of the criteria and recommended standard for inorganic lead. Keith H. Jacobson, Ph.D., had program responsibility and Robert E. Seiter served as criteria manager. Frank W. Mackison had program responsibility for preparation of the revised recommended standard for inorganic lead.

NIOSH REVIEW COMMITTEE
FOR
REVISED RECOMMENDED INORGANIC LEAD STANDARD

Edward L. Baker, M.D.
Bureau of Epidemiology
Center for Disease Control

Kenneth Bridboard, M.D.
Office of Extramural Coordination
and Special Projects

John M. Bryant
Division of Physical Science
and Engineering

Frank L. Mitchell, D.O.
Division of Criteria Documentation
and Standards Development

Theodore Thoburn, M.D.
Division of Surveillance, Hazard Evaluation
and Field Studies

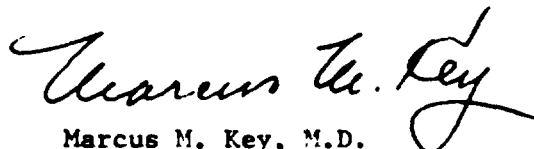
Robert H. Schutz
Division of Safety Research

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. To provide relevant data from which valid criteria and effective standards can be deduced, the National Institute for Occupational Safety and Health has projected a formal system of research, with priorities determined on the basis of specified indices.

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 inorganic lead by my staff and the valuable constructive comments by the Review Consultants on Inorganic Lead, by the ad hoc committee of the American Academy of Industrial Hygiene, by Robert P. O'Connor, M. D., NIOSH consultant in occupational medicine, and Edwin C. Hyatt on respiratory protection. The NIOSH recommendations for standards are not necessarily a consensus of all of the consultants and professional societies that reviewed this criteria document on inorganic lead. A list of the NIOSH Review Committee members and of the Review Consultants appears on pages iii and iv. [revised pages vii and viii].



Marcus M. Key, M.D.
Director, National Institute
for Occupational Safety and Health

NIOSH REVIEW COMMITTEE ON
INORGANIC LEAD

Thomas L. Anania
Division of Technical Services

John M. Bryant
Acting Deputy Director
Division of Laboratories and Criteria Development

Paul E. Caplan
Deputy Director,
Division of Technical Services

Herbert E. Christensen, D.Sc.
Deputy Assistant Institute Director for
Research and Standards Development

Lester D. Scheel, Ph.D.
Division of Laboratories and Criteria Development

Robert N. Ligo, M.D.
Division of Technical Services

Harry Gilbert
Occupational Safety and Health Administration
Office of Standards
Department of Labor

NIOSH REVIEW CONSULTANTS ON
INORGANIC LEAD

Frederick A. Linde
Presidential Assistant for Health and Safety
Oil, Chemical and Atomic Workers International Union
Denver, Colorado 80201

Kenneth W. Nelson
Director, Department of Environmental Sciences
American Smelting & Refining Company
Salt Lake City, Utah 84119

Leonard D. Pagnotto
Chief of Laboratory
Division of Occupational Hygiene
Massachusetts Department of Labor and Industries
Boston, Massachusetts 02116

Lawrence T. Schafer
Associate Professor of Environmental Health
University of Cincinnati College of Medicine
Cincinnati, Ohio 45219

Ralph G. Smith, Ph.D.
Professor of Environmental and Industrial Health
University of Michigan School of Public Health
Ann Arbor, Michigan 48104

Carl Zenz, M.D.
Medical Director,
Allis-Chalmers Manufacturing Company
West Allis, Wisconsin 53214

CRITERIA DOCUMENT: REVISED RECOMMENDATIONS FOR AN
OCCUPATIONAL EXPOSURE STANDARD FOR INORGANIC LEAD

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I. REVISED RECOMMENDATION FOR AN INORGANIC LEAD STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that employee exposure to inorganic lead in the workplace be controlled by adherence to the following sections. The standard is designed to protect the health and safety of workers for a 10-hour day, 40-hour week over a working lifetime; compliance with the standard should therefore prevent adverse effects of lead on the health and safety of workers. 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.

"Inorganic lead" means lead oxides, metallic lead, and lead salts (including organic salts such as lead soaps but excluding lead arsenate). "Exposure to inorganic lead" is defined as exposure above half the recommended workroom environmental standard. Exposures at lower environmental concentrations will not require adherence to the following sections, except for Section 7(a).

Section 1 - Environmental (workplace air) - (see NIOSH testimony Appendix V - page XII-1)

(a) Concentration

Occupational exposure to inorganic lead shall be controlled so that workers shall not be exposed to inorganic lead at a concentration greater than 0.10 mg Pb/m³ determined as a time-weighted average (TWA) exposure for an 10-hour workday, 40-hour work week.

(b) Sampling and Analysis

Procedures for collection of environmental samples shall be as provided in Appendix I, or by an equivalent method. Analysis of samples shall be as provided in Appendix II, or by any method shown to be equivalent in precision and accuracy to the method specified in Appendix II.

Section 2 - Medical - (see NIOSH testimony Appendix V - page XII-1)

Medical monitoring (biologic monitoring and medical examinations) shall be made available to workers as outlined below.

(a) Biologic monitoring

Biologic monitoring shall be made available to all workers subject to "exposure to inorganic lead." This consists of sampling and analysis of whole blood for lead content. Such monitoring shall be performed to ensure that no worker absorbs an unacceptable amount of lead. Unacceptable absorption of lead posing a risk of lead poisoning is demonstrated at levels of 0.060 mg Pb/100 g of whole blood or greater.

Procedures for sampling and analysis of blood for lead shall be as described in Appendix II, or by any method shown to be equivalent in precision and accuracy.

All workers subject to "exposure to inorganic lead" shall be offered biologic monitoring at least every 6 months. The schedule of biologic monitoring may be made more frequent if indicated by a professional industrial hygiene survey. If environmental sampling and analysis show that environmental levels are at or greater than the recommended environmental levels, the interval of biologic monitoring shall be halved, i.e. blood analysis shall be conducted quarterly. This increased frequency shall be continued for at least 6 months after the high environmental level has been shown.

If a blood lead level of 0.060 mg Pb/100 g or greater is found, and confirmed by a second sample to be taken within two weeks, steps to reduce absorption of lead shall be taken as soon as the high levels are confirmed. Steps to be considered should include improvement of environmental controls, of personal protection or personal hygiene, and use of administrative controls. A medical examination for possible lead poisoning shall be made available to workers with unacceptable blood lead levels.

(b) Medical examination

Medical examinations should be made available prior to employee placement and annually thereafter unless a different frequency is indicated by professional medical judgment based on such factors as emergencies, variations in work periods, and preexisting health status of individual worker. These examinations should focus on the blood-forming elements, the kidney, and the nervous and reproductive systems. They should include a physical examination, complete blood counts, blood lead determinations, routine urinalysis (specific gravity, sugar and protein determinations, and microscopic examination), and should record any signs or symptoms of plumbism, if present. It should be noted that, in addition to the recommended methods for blood analysis, zinc protoporphyrin (ZPP) shows promise of being a very useful, more direct measure of lead activity. This additional blood test may be considered as an adjunct to the biologic monitoring program.

Each employee who absorbs unacceptable amounts of lead as indicated by biologic monitoring shall be examined as soon as practicable after such absorption is demonstrated and confirmed, and at least every 3 months thereafter until blood lead levels have returned to below the acceptable limit, i.e. below 0.060 mg/100 g of blood. If clinical evidence of

plumbism is developed from these medical examinations, the worker shall be kept under a physician's care until the worker has completely recovered or maximal improvement has occurred.

Medical records shall include information on all biologic determinations and on all required medical examinations. These records shall be available to the medical representatives of the employer, of the Secretary of Labor, of the Secretary of Health, Education, and Welfare, and, at the employee's request, to the employee's physician. These records shall be kept for at least 30 years after the last occupational exposure to inorganic lead.

Section 3 - Labeling (Posting)

Areas where exposure to lead at levels greater than one-half the workroom air standard is likely to occur shall be posted with a sign reading:

LEAD (Pb)

DANGER!

High concentrations of fume or dust

may be hazardous to health.

Provide adequate ventilation.

If environmental levels are at or greater than the environmental limit, or if a variance permitting use of respiratory controls has been granted, add information to the label or placard describing the location of the respirators.

Section 4 - Personal Protective Equipment and Work Clothing

The employer shall use engineering controls if needed to maintain concentrations of airborne inorganic lead at or below the limits specified in Section 1 (a) and shall provide protective work clothing as specified in subsection (b) of this Section. When the limits of exposure to inorganic lead prescribed in Section 1 (a) cannot be met by limiting the concentration of inorganic lead in the work environment, an employer must utilize, as provided in subsection (a) of this Section, a program of respiratory protection to effect the required protection of every worker exposed.

(a) Respiratory Protection

Engineering controls shall be used wherever feasible to maintain inorganic lead concentrations at or below the prescribed limits. Compliance with the prescribed limits by the use of respirators is allowed only when inorganic lead concentrations are in excess of the workplace environmental limit because required engineering controls are being installed or tested, when nonroutine maintenance or repair is being accomplished, or during emergencies. Appropriate respirators as described in Table I-1 shall only be selected and used pursuant to the following requirements:

(1) For the purpose of determining the class of respirator to be used, the employer shall measure the atmospheric concentration of inorganic lead in the workplace initially and thereafter whenever process, worksite, climate, or control changes occur which are likely to increase the inorganic lead concentration.

(2) The employer shall ensure that no employee is exposed to inorganic lead above the recommended limit because of improper respirator selection, fit, use, or maintenance.

(3) Employees experiencing breathing difficulty while using respirators shall be referred to a physician for evaluation. This evaluation should investigate if the employee has adequate ventilatory capacity, any evidence of obstructive lung disease, and the employees ability to use negative or positive pressure respirators.

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

(5) The employer shall provide respirators in accordance with the Table I-1, below and shall assure that the employee uses the respirator provided at all times when the concentration of inorganic lead exceeds the permissible limit.

(6) If both fume and dust are present, the recommended usage is that for fume.

(7) The employer shall provide respirators in accordance with Table I-1 and shall ensure that the employees properly use the respirators provided when wearing respirators is required. The respiratory protective devices provided in conformance with Table I-1 shall be those approved by NIOSH and the Mining Enforcement and Safety Administration (MESA) as specified under the provision of 30 CFR 11.

(8) The employer shall ensure that employees are properly instructed in the use of respirators assigned to them and on how to test for leakage, proper fits, and proper operation.

TABLE I-1

Requirements for Respirator Usage
at Concentrations Above the Standard

Airborne Particulate

Concentration of Lead

Required Respirator

Not in excess of 0.5 mg/m ³	Any dust and mist respirator, except single-use.
Not in excess of 1 mg/m ³	Any dust and mist respirator, except single-use respirator or quarter mask.
	Any fume respirator or high efficiency particulate filter respirator.
	Any supplied-air respirator.
	Any self-contained breathing apparatus.
Not in excess of 5 mg/m ³	A high efficiency particulate filter respirator with a full facepiece.
	Any supplied-air respirator with a full facepiece.
	Any self-contained breathing apparatus with a full facepiece.
Not in excess of 100 mg/m ³	A powered air-purifying respirator with a high efficiency particulate filter.

A Type C supplied-air respirator operated in pressure-demand or other positive-pressure or continuous-flow mode.

Not in excess of 200 mg/m³

A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive-pressure mode or with a full facepiece, helmet or hood operated in continuous-flow mode.

Greater than 200 mg/m³
or entry and escape from
unknown concentrations

Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive-pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

Fire-Fighting

Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

(b) Work Clothing

(1) Coveralls or other full-body protective clothing shall be worn in areas where there is occupational exposure to inorganic lead. Protective clothing shall be changed at least daily at the end of the shift and more frequently if it should become grossly contaminated.

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

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

(4) The employer shall ensure that precautions necessary to protect laundry personnel are taken when soiled protective clothing is laundered.

Section 5 - Appraisal of Employees of Hazards from Inorganic Lead

(a) Each employee exposed to lead shall be apprised at the beginning of his employment or assignment to a lead area of all hazards, relevant symptoms, appropriate emergency procedures, and proper conditions and precautions for safe use or exposure and shall be instructed as to availability of such information which shall be kept on file, including that prescribed in (b) below, and shall be accessible to the worker at each place of employment where lead is involved in unit processes and operations.

(b) Information as specified in Appendix III shall be recorded on U.S. Department of Labor Form OSHA-20, "Material Safety Data Sheet", (see page IX-4 and IX-5), or on a similar form approved by the Occupational Safety and Health Administration, U.S. Department of Labor.

Section 6 - Work Practices

(a) Emergency Procedures

(1) Procedures including fire fighting procedures shall be established and implemented to meet foreseeable emergency events.

(2) Respirators shall be available for wearing during evacuation procedures if long distances need to be traversed; supplied air respirators shall be available for employee use where equipment or operations cannot be abandoned.

(b) Exhaust Systems

Where a local exhaust ventilation and collection system is used, it shall be designed and maintained to prevent the accumulation of lead dust and fume.

(1) Hazardous types of exposure should not be scattered throughout a plant but, rather, concentrated in a single area where special control procedures can be utilized.

(2) Air from the exhaust ventilation systems shall not be recirculated into the workroom, and should not be discharged outside the plant so as to create an air pollution problem.

(c) General Housekeeping

(1) Vacuuming shall be used wherever practicable and no dry sweeping or blowing shall be performed.

(2) Emphasis shall be placed upon cleanup of spills, periodic repair of equipment and leaks, proper storage of materials, and collection of lead-containing dust.

Section 7 - Sanitation

(a) Food preparation, dispensing (including vending machines), and

eating shall be prohibited in lead work areas.

(b) Work and street clothing should not be stored in the same locker.

(c) Smoking or smoking materials shall not be permitted in areas where exposure to inorganic lead may occur.

Section 8 - Monitoring, Recordkeeping, and Reporting Requirements

Workroom areas where it has been determined, on the basis of an industrial hygiene survey or the judgment of a compliance officer, that environmental levels do not exceed half the environmental standard shall not be considered to have inorganic lead exposure. Records of these surveys, including the basis for concluding that air levels are below half the environmental standard, shall be kept. Surveys shall be repeated at least annually and within 30 days of any changes likely to result in increased concentrations of airborne inorganic lead.

(a) Employers shall monitor environmental levels of inorganic lead at least every 6 months, except as otherwise indicated by a professional industrial hygiene survey. If environmental levels are at or above the standard, environmental levels shall be monitored every 3 months. This increased frequency of monitoring shall be continued at least 6 months (i.e. two more quarterly monitoring periods) after the last sampling that demonstrated levels at or above the environmental limit.

Periodic environmental sampling shall be performed to coincide with periodic biologic sampling, i.e. shall be performed within 2 weeks of biologic sampling.

Breathing zone samples shall be collected to permit construction of a time-weighted average exposure for every operation.*

(b) Records shall be maintained for all sampling schedules to include the sampling methods, analytical methods, type of respiratory protection in use (if applicable), and the concentrations of inorganic lead in each work area. Records shall be maintained so that they can be classified by employee. Each employee shall be able to obtain information on his own environmental exposure.

(c) Medical records shall include information on all biologic determinations and of all required medical examinations. These records shall be kept for at least 30 years following the last occupational exposure to inorganic lead.

*Guidance for establishing worker exposure measurements are given in DHEW(NIOSH) Publication No 77-173, Occupational Exposure Sampling Strategy Manual, available from the Division of Technical Services, 4676 Columbia Parkway, Cincinnati, Ohio 45226.

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 inorganic lead. 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. It should be pointed out that any recommended criteria for a standard should enable management and labor to develop better engineering controls resulting in more healthful work practices and should not be used as a final goal.

These criteria for a standard for inorganic lead are in a continuing series of criteria developed by NIOSH. The proposed standard applies only to the processing, manufacture, and use of lead products as applicable under the Occupational Safety and Health Act of 1970.

The occupational safety and health aspects of the mining and milling of lead ores are covered by provisions of the Federal Metal and Non-metallic Mine Safety Act (30 U.S.C. 725 et seq.) under which provisions the Bureau of Mines has responsibility.

These criteria were developed to assure that the standard based thereon would (1) protect against development of acute and chronic plumbism, (2) be measureable by techniques that are valid, reproducible, and available to industry and governmental agencies, and (3) be attainable with existing technology.