

NIOSH

criteria for a recommended standard
occupational exposure to

zinc oxide

The image shows a grid structure consisting of 14 vertical bars and 7 empty boxes. The bars are arranged in two rows of seven. The top row of bars is filled with a dark, grainy texture, while the bottom row of bars is empty. Below each bar in the top row is a corresponding empty white box. This layout is typical of a data visualization template where the bars represent data points and the boxes below them are for labels or values.

criteria for a recommended standard

**OCCUPATIONAL EXPOSURE
TO
ZINC OXIDE**



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

Center for Disease Control

National Institute for Occupational Safety and Health

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PREFACE

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

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

I am pleased to acknowledge the contributions to this report on zinc oxide by members of my staff and the valuable and constructive comments by the Review Consultants on Zinc Oxide, by the ad hoc committees of the American Academy of Occupational Medicine and the American Academy of Industrial Hygiene, by Robert B. O'Connor, M.D., NIOSH consultant in occupational medicine, and by Bruce J. Held on respiratory protection. NIOSH recommendations for standards are not necessarily a consensus of all

the consultants and professional societies that reviewed this criteria document on zinc oxide. Lists of the NIOSH Review Committee members and of the Review Consultants appear on the following pages.

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The Office of Research and Standards Development, National Institute for Occupational Safety and Health, had primary responsibility for development of the criteria and the recommended standard for zinc oxide. Tabershaw-Cooper Associates, Inc., developed the basic information for consideration by the NIOSH staff under contract No. HSM-99-73-50. John M. Fajen of Stanford Research Institute developed the final document for consideration by the NIOSH staff and consultants under contract No. CDC-99-74-31. Douglas L. Smith, Ph.D., had NIOSH program responsibility for development of the document.

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CRITERIA DOCUMENT: RECOMMENDATIONS FOR AN
OCCUPATIONAL EXPOSURE STANDARD FOR ZINC OXIDE

Table of Contents

	<u>Page</u>
PREFACE	iii
REVIEW COMMITTEES	vi
I. RECOMMENDATIONS FOR A ZINC OXIDE STANDARD	
Section 1 - Environmental (Workplace Air)	1
Section 2 - Medical	2
Section 3 - Labeling (Posting)	3
Section 4 - Personal Protective Equipment	3
Section 5 - Informing Employees of Hazards from Zinc Oxide	6
Section 6 - Work Practices	6
Section 7 - Sanitation Practices	7
Section 8 - Monitoring and Recordkeeping Requirements	7
II. INTRODUCTION	10
III. BIOLOGIC EFFECTS OF EXPOSURE	
Extent of Exposure	12
Historical Reports	13
Effects on Humans	14
Epidemiologic Studies	26
Animal Toxicity	29
Correlation of Exposure and Effect	36
IV. ENVIRONMENTAL DATA	
Environmental Concentrations	39
Environmental Sampling and Analytical Methods	41
Control of Exposure	42
V. DEVELOPMENT OF STANDARD	
Basis for Previous Standards	45
Basis for Recommended Environmental Standard	46
VI. REFERENCES	52

CRITERIA DOCUMENT: RECOMMENDATIONS FOR AN
OCCUPATIONAL EXPOSURE STANDARD FOR ZINC OXIDE

Table of Contents
(continued)

	<u>Page</u>
VII. APPENDIX I - Method for Sampling for Zinc Oxide in Air	59
VIII. APPENDIX II - Method for Analysis of Zinc Oxide in Air	63
IX. APPENDIX III - Material Safety Data Sheet	68
X. APPENDIX IV - Tables and Figure	78

I. RECOMMENDATIONS FOR A ZINC OXIDE STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that worker exposure to zinc oxide (ZnO) fume or dust in the workplace be controlled by adherence to the following sections. The standard is designed to protect the health and safety of workers for up to a 10-hour workday, 40-hour workweek over a working lifetime; compliance with all the sections of the standard should therefore prevent adverse effects of zinc oxide fume or dust 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 standard will be subject to review and revision as necessary.

"Exposure to zinc oxide" is defined as exposure above half the recommended time-weighted average environmental limit.

Section 1 - Environmental (Workplace Air)

(a) Concentration

Occupational exposure to zinc oxide shall be controlled so that workers are not exposed to zinc oxide at an environmental concentration greater than 5 mg ZnO/cu m determined as a time-weighted average (TWA) exposure for up to a 10-hour workday, 40-hour workweek, with a ceiling of 15 mg ZnO/cu m as determined by a sampling time of 15 minutes.

(b) Sampling and Analysis

Procedures for sampling and analysis of environmental samples shall be as provided in Appendices I and II, or by any equivalent method.

Section 2 - Medical

Medical surveillance shall be made available as specified below for all persons occupationally exposed to zinc oxide.

(a) Preplacement medical examinations shall include:

- (1) Comprehensive or interim work history.
- (2) Comprehensive or interim medical history.
- (3) The examination shall give special emphasis to the respiratory tract. Such tests as chest X-rays and pulmonary function studies may be considered by the responsible physician.

(b) Appropriate emergency health care shall be provided for workers with adverse effects from zinc oxide.

(c) Initial examinations for presently employed workers shall be offered within 6 months of the promulgation of a standard incorporating these recommendations, and at subsequent intervals determined by the responsible physician.

(d) Medical records shall be maintained for persons employed for one or more years in work involving exposure to zinc oxide and shall include information on all required medical examinations and all reported episodes of metal fume fever. Medical records with pertinent supporting documents shall be maintained at least 5 years after the individual's employment is terminated. Pertinent medical records shall be available to the medical representatives of the Secretary of Health, Education, and

Welfare, of the Secretary of Labor, of the employee or former employee, and of the employer.

Section 3 - Labeling (Posting)

(a) The following sign shall be posted in readily visible locations in any work area where there is the likelihood of occupational exposure to zinc oxide:

CAUTION

ZINC OXIDE AREA

Harmful If Inhaled

Use Only With Adequate Exhaust
Ventilation or Approved Respiratory
and Personal Protective Devices.

(b) The posting required under Section 3 (a) shall be printed in English and in the predominant language of non-English-speaking workers, if any, unless they are otherwise trained and informed of the hazardous areas. All illiterate workers shall receive such training.

Section 4 - Personal Protective Equipment

(a) Protective clothing

It is recommended that employees wear coveralls or equivalent during working hours.

(b) Respiratory Protection

(1) Engineering controls shall be used wherever possible to maintain zinc oxide concentrations below the prescribed limits.

Compliance with the permissible exposure limit may not be achieved by the use of respirators except:

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

(B) For nonroutine operations such as a brief exposure to concentrations in excess of the permissible exposure limit as a result of maintenance or repair activities.

(C) During emergencies when air concentrations of zinc oxide may exceed the permissible limit.

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

(A) For the purpose of determining the type of respirator to be used, the employer shall measure, whenever possible, the atmospheric concentration of zinc oxide in the workplace initially and thereafter whenever process, worksite, climate, or control changes occur which are likely to increase the zinc oxide concentrations. This requirement shall not apply when only atmosphere-supplying positive pressure respirators are to be used. The employer shall ensure that no worker is being exposed to zinc oxide in excess of the standard because of improper respirator selection, fit, use, or maintenance.

(B) A respiratory protection program meeting the requirements of 29 CFR 1910.134 and 30 CRF 11.2-1 shall be established and enforced by the employer.

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

respirator provided.

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

TABLE I-1
REQUIREMENTS FOR RESPIRATOR USAGE AT CONCENTRATIONS
ABOVE THE TWA OR CEILING LIMIT*

Maximum Use Concentration (Multiples of TWA limit)	Respirator Type for Zinc Oxide
Less than or equal to 5x	Single use (valveless type) dust or fume filter.
Less than or equal to 10x	(1) Air-purifying quarter or half mask respirator with replaceable dust or fume filter or single use (with valve) dust or fume respirator. (2) Type C demand type (negative pressure) supplied-air respirator, with half mask facepiece.
Less than or equal to 100x	(1) Air-purifying full facepiece respirator with replaceable dust or fume filter. (2) Type C demand type (negative pressure) supplied-air respirator, with full facepiece.
Less than or equal to 200x	Powered air-purifying (positive pressure) respirator with applicable replaceable dust or fume filter.
Greater than 200x	Type C continuous flow type (positive pressure) supplied-air respirator.

* For abrasive blasting in metal cleaning use only Type CE positive pressure supplied-air respirator with hood or helmet.

(E) Respirators specified for use in higher concentrations of zinc oxide may be used in atmospheres of lower concentrations.

(F) The employer shall ensure that respirators are adequately cleaned, and that employees are instructed on the use of respirators assigned to them, and how to test for leakage.

Section 5 - Informing Employees of Hazards from Zinc Oxide

At the beginning of employment in a zinc oxide area, workers shall be informed of the hazards, relevant symptoms of overexposure, and proper conditions and precautions for safe exposure to zinc oxide. Circumstances under which zinc oxide may be generated shall be particularly emphasized. The information shall be kept on file and readily accessible to the worker at all places of employment where zinc oxide may be encountered. Information shall be recorded as specified in Appendix III, "Material Safety Data Sheet," or on a similar form approved by the Occupational Safety and Health Administration, US Department of Labor.

Section 6 - Work Practices

(a) Where a local exhaust ventilation system is used, it shall be designed, maintained, and utilized to limit the amount of zinc oxide dispersed into the workplace. Air from such an exhaust ventilation system should not be recirculated into the workroom environment or discharged outside the plant unless adequately cleaned to meet applicable air pollution codes.

(b) Local exhaust ventilation, located as close as practicable to the operation, shall be used whenever welding, cutting, or related high-temperature operations are performed in tanks or other enclosed locations.

(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 prompt cleanup of dust, periodic repair of equipment, and proper storage of materials.

Section 7 - Sanitation Practices

Sanitation requirements shall include the following and shall comply with 29 CFR 1910.141:

(a) Hand washing facilities with soap and clean towels.

(b) Locker for clothing.

Section 8 - Monitoring and Recordkeeping Requirements

Workroom areas shall not be considered to have zinc oxide exposure if environmental levels, as determined on the basis of an industrial hygiene survey or by the judgment of the compliance officer, do not exceed half of the recommended TWA limit. Records of these surveys, including the basis for concluding that air levels are at or below half of the TWA limit, shall be maintained until a new survey is conducted. Workroom areas where there is exposure to zinc oxide shall be monitored in accordance with the specifications contained in the following subsections:

(a) Semiannual requirements: Employers shall monitor environmental levels of zinc oxide at least every 6 months, except as otherwise indicated by the judgment of a professional industrial hygienist. Also, surveys shall be repeated when any change in operations, processes, worksite, climate, or control indicates a need for reevaluation or at the discretion of the compliance officer. Samples shall be collected in the breathing zone of workers in accordance with the numbers specified in Table I-2. Sampling shall take into consideration variations in exposure arising in welding, burning, or related operations because of work on materials having various types of coatings of zinc or zinc compounds. The minimum number of representative TWA determinations for an operation or process shall be based on the number of workers exposed as provided in Table I-2 or as otherwise indicated by a professional industrial hygienist.

TABLE I-2
SAMPLING SCHEDULE

Number of Employees Exposed	Minimum Number of Employees Whose Individual Exposures Shall Be Determined
1-20	50% of the number of workers
21-100	10 samples plus 25% of the excess over 20 workers
over 100	30 samples plus 5% of the excess over 100 workers

(b) If semiannual samples show the environmental concentration of zinc oxide to be in excess of the recommended limits, suitable controls shall be initiated to reduce the exposure level to, or below, the recommended standard. In such cases monitoring shall continue at 30-day intervals until 2 consecutive surveys indicate the recommended limits are no longer exceeded. Periodic review and evaluation of environmental and medical data shall be performed to determine the effectiveness of control measures.

(c) Records of all sampling and of medical examinations shall be maintained for at least 5 years after the individual's employment is terminated. Records shall indicate the type of respiratory protective devices, if any, in use at the time of sampling. Records shall be maintained so that they can be classified to the extent possible by the employee. Each employee shall be able to obtain information on his own environmental exposure.

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 zinc oxide fume or dust. 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 recommendations for a standard for zinc oxide fume or dust are part of a continuing series of criteria being developed by NIOSH. The proposed standard applies only to occupational exposures to zinc oxide as applicable under the Occupational Safety and Health Act of 1970.

Although zinc oxide is manufactured and utilized in substantial quantities, the occupational exposures of principal concern are those to

freshly formed zinc oxide fume produced by subjecting zinc or some of its compounds to high temperatures. Education of potentially exposed workers to be on the alert for unexpected sources is therefore important.