NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND SUPPORTING DOCUMENTATION FOR

*** ZINC OXIDE FUME ***

NIOSH/OSHA Draft Technical Standard and Supporting Documentation for ZINC OXIDE FUME

The basic text of this document contains the draft technical standard approved by the Joint Review Committee of the NIOSH/OSHA Standards Completion Program and the supporting documentation for the substance ZINC OXIDE FUME.

The SCP draft technical standards are recommendations to the Department of Labor for its consideration in rulemaking and have no legal status until final rules have been promulgated by that agency. This draft standard is provided for your information only.

The References and Sources, Respirator Table Documentation and Use/Exposure and Control Documentation are the working documents used by the various SCP working groups during the development of the draft technical standard and serve as the technical foundation for the standard. The classification for each substance and the regulatory statements were derived following a decision logic established for the various sections of the standard.

(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of zinc oxide fume not in excess of 5 milligrams per cubic meter (mg/M3) averaged over an eight-hour work shift (time weighted average), as stated in $ 1910.1000, Table Z-1.

(2) "Action level" means one half of the permissible exposure for zinc oxide fume.

(b) Exposure determination and measurement. (1) Each employer who has a place of employment in which zinc oxide fume is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of zinc oxide fume at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of zinc oxide fume.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to zinc oxide fume;

(ii) Any measurements of zinc oxide fume taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to zinc oxide fume; and

(iv) Date of determination, work being performed at the time, location within work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to zinc oxide fume at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b) (3) of this section reveals employee exposure to zinc oxide fume at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to zinc oxide fume at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to zinc oxide fume above the permissible exposure, the employer shall:

(i) Measure the exposure monthly of the employee so exposed; and

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to zinc oxide fume above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to zinc oxide fume below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph, employee exposure is that which would occur if the employee were not using a respirator.

(c) Methods of measurement. (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (See Appendix B (IV) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

Table 1

Concentration	Required Accuracy
Above permissible exposure	± 25%
At or below permissible exposure and above the action level	± 35%
At or below the action level	± 50%

(d) Compliance. (1) No employee shall be exposed to zinc oxide fume above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of zinc oxide fume shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not technically feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of zinc oxide fume.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of zinc oxide fume to at or below the permissible exposure; or

(iv) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2 RESPIRATORY PROTECTION FOR ZINC OXIDE FUME

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Particulate Concentration	
50 mg/M3 or less	Any fume respirator or high efficiency particulate filter respirator. Any supplied-air respirator. Any self-contained breathing apparatus.
250 mg/M3 or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet or hood. Any self-contained breathing apparatus with a full facepiece.
2,500 mg/M3 or less	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.
Greater than 2,500 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.

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e), and (f).

(e) Fire and safety. The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for zinc oxide fume.

(f) Reserved.

(g) Reserved.

(h) Reserved.

(i) Training and information. (1) Each employer who has a workplace in which zinc oxide fume is present shall keep a copy of this regulation with Appendixes A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to zinc oxide fume above the action level or employees or employees who work where a potentially hazardous release of zinc oxide fume may occur, shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for zinc oxide fume (Appendix A of this section);

(ii) Advise affected employees as to the signs and symptoms of exposure to zinc oxide fume.

(iii) Instruct affected employees to advise the employer of the development of signs and symptoms of exposure to zinc oxide fume which are listed in Appendix A of the section; and

(iv) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to zinc oxide fume.

(j) Medical surveillance. (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall make available to each employee who is to be exposed to airborne concentrations of zinc oxide fume at or above the action level a medical examination which shall include the following:

(i) A medical history and physical examination with emphasis on the lungs and skin.

(ii) 14" x 17" chest roentgenogram.

(iii) Forced vital capacity (FVC) and forced expiratory volume-one second (FEV (1 second)) tests.

(3) The employer shall obtain from the physician, as a record of the examination, the following information:

(i) A written opinion which conforms with paragraph (j)(7) of this section.

(ii) 14" x 17" chest roentgenogram or a medically acceptable copy.

(iii) A record of the results of the pulmonary function testing.

(4) The employer shall make available to each employee, exposed to zinc oxide fume in excess of the action level at 12 months from the date of the employee's first exposure, and at every 12 months of exposure in excess of the action level thereafter, a medical examination which must include the following:

(i) A medical history and physical examination with emphasis on the lungs and skin.

(ii) 14" x 17" chest roentgenogram (only when indicated by results of pulmonary function testing, FVC and FEV (1 sec)).

(iii) Forced vital capicity (FVC) and forced expiratory volume -one second (FEV (1 second)) tests;

(5) The employer shall obtain from the physician, as a record of the periodic examination, the following information:

(i) A written opinion which conforms with paragraph (j)(7) of this section.

(ii) 14" x 17" chest roentgenogram or a medically acceptable copy.

(iii) A record of the results of the pulmonary function testing.

(6) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with its appendixes A, B, and C for zinc oxide fume;

(ii) A description of the employee's duties as they relate to his exposure to zinc oxide fume;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements, which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure; and

(vi) Upon request of the physician, any available information from previous medical examination of the affected employee.

(7)(i) The physician's written opinion shall be a signed statement by the examining physician specifically stating: (A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to zinc oxide fume or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to zinc oxide fume, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to zinc oxide fume.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(8) No employee shall be exposed to airborne concentrations of zinc oxide fume in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(9) The employer shall provide emergency and follow-up medical examinations and treatment for any employee injured through exposure to zinc oxide fume.

(10) If the examining physician chooses to use alternative medical examinations to those specified in paragraphs (j)(2) and (4) of this section, the employer may accept such alternative medical surveillance examinations as meeting the requirements of this part provided that the employer:

(i) Obtains a statement from the examining physician setting forth the alternative medical examinations and the rationale for substitution and evidence that they will be equally effective.

(ii) Informs each exposed employee of the fact that alternative medical examinations to those required in paragraphs (j)(2) or (4) of this section are to be made available.

(11) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risks involved by refusing to be examined.

(12) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) Recordkeeping. (1) Exposure determination. (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) This record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) Exposure measurements. (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to zinc oxide fume.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to zinc oxide fume which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) Mechanical ventilation. (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken;

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) Employee training and information. (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained;

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) Medical surveillance. (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Results of tests required by paragraph (j)(2) and (j)(4) of this section and results of any tests conducted pursuant to paragraphs (j)(4) of this section;

(B) Any employee medical complaints relative to exposure to zinc oxide fume;

(C) A copy of information provided to the physician pursuant to paragraph (j)(6)(ii), (iii), (iv), (v), and (vi) of this section.

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration and for five years after termination of the employment of the affected employee.

(6) Access to records. (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(l) Employee observation of measurement. (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to zinc oxide fume which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to zinc oxide fume requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure.

(ii) Visually observe all steps related to the measurement of the airborne concentration of zinc oxide fume that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE: The information contained in the following appendixes is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for ZINC OXIDE FUME

APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR ZINC OXIDE FUME

I. SUBSTANCE IDENTIFICATION

A. Substance: Zinc oxide fume

B. Permissible Exposure: 5 milligrams of zinc oxide fume per cubic meter of air (mg/M3) averaged over an eight-hour work shift.

C. Appearance: White fume

II. HEALTH HAZARD DATA

A. Ways in which the chemical affects your body: Zinc oxide fume can affect your body if you inhale it.

B. Effects of Overexposure:

1. Short-Term: Zinc oxide fume causes a flu-like illness called metal fume fever. Symptoms of metal fume fever include headache, fever, chills, muscle aches, nausea, vomitting, weakness and tiredness. The symptoms usually start several hours after exposure. The attack may last 6 to 24 hours. Metal fume fever is more likely to occur after a period away from the job (after weekends or vacations). High levels of exposure to zinc oxide fume may cause a metallic or sweet taste in the mouth, dryness and irritation of the throat and coughing at the time of exposure.

2. Long-term Exposure: None known.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by exposure to zinc oxide fume.

III. EMERGENCY FIRST AID PROCEDURES

A. Breathing: If you or any other person breathes in large amounts of zinc oxide fume move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

B. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: Respirators are not the best way to control exposure to zinc oxide fume. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine

activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where there use is required. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: Not applicable.

C. Eye Protection: Not applicable.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

A. Zinc oxide fume should not be allowed to come in contact with chlorinated rubber.

B. Ask your supervisor where zinc oxide fume may be inadvertently released in your work area and for any additional safety and health rules.

VI. ACCESS TO INFORMATION

A. Each year your employer is required to inform you of the information contained in this Substance Safety Data Sheet for zinc oxide fume. In addition, your employer must instruct you in emergency procedures, and the correct use of protective equipment.

B. Your employer is required to determine whether you are being exposed to zinc oxide fume. You or your representative have the right to observe employee exposure measurements and to record the results obtained. If your employer determines that you are being overexposed, he is required to inform you of the exposure and of the actions which are being taken to reduce your exposure.

C. Your employer is required to keep records of exposure determinations, exposure measurements, and medical surveillance. Your employer is required to make records of exposure determinations and your exposure measurements available to you or your representative upon your request. Your employer is required to release your medical records to your physician upon your written request.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES FOR ZINC OXIDE FUME

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: None
2. Formula: ZnO

3. Molecular weight: 81.37

B. Physical Data

1. Boiling Point (760 MM Hg): Solid sublimes
2. Specific gravity (water = 1): 5.6 (solid)
3. Vapor density (air = 1 at boiling point of zinc oxide fume): Not applicable
4. Melting point: (greater than 1800 C)(greater than 3272 F).
5. Vapor pressure at 20 C (68 F): Not applicable
6. Solubility in water, % by weight at 20 C (68 F): Insoluble (solid)
7. Evaporation rate (butyl acetate = 1): Not applicable
8. Appearance: White fume

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Not combustible

B. Reactivity

1. Conditions contributing to instability: None.
2. Incompatibilites: Zinc oxide fume may react violently with chlorinated rubber.
3. Hazardous decomposition products: None.
4. Special precautions: None.

III. LEAK PROCEDURES

A. If potentially hazardous amounts of zinc oxide fume are inadvertently released, ventilate the area of the release to disperse the fume.

B. Persons not wearing protective equipment should be restricted from areas of releases until cleanup has been completed.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the average 8-hour exposure may be determined from a single eight-hour sample or two 4-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR part 84, portable direct-reading instruments, dosimeters, or by collection of the particulates using a high efficiency membrane filter with subsequent chemical analyses. The method of measurement must determine the concentration ofzinc oxide fume to plus or minus 35%.

B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring and measurements under this section should be essentially the same as described under paragraph IV. A. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association. The method of measurement must determine the concentration ofzinc oxide fume to plus or minus 25%.

C. METHODS: Methods meeting these accuracy requirements are available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161 under the title "NIOSH Analytical Methods for Set O" (Order number XXXXXXXXXX).

D. QUALIFIED PERSONS: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

A. Employers should advise employees of all areas and operations where exposure to zinc oxide fume could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to zinc oxide fume is likely to occur are: During the manufacture of zinc oxide from metallic zinc by burning zinc vapor; during the reduction of zinc oxide to metallic zinc; during the roasting of zinc sulfide ores; during the use of zinc alloys at high temperatures; during the brazing, welding, burning or cutting of zinc and galvanized metals; during the abrasive cleaning of galvanized metal surfaces; and during use of zinc oxide as a ceramic flux.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

Inhalation of zinc oxide fume causes an influenza-like illness termed metal fume fever. Heavy human exposure to zinc oxide fume may cause an immediate dryness and irritation of the throat, a sweet or metallic taste followed by substernal tightness and constriction in the chest, and a dry cough. Several hours following exposure the subject develops chills, lassitude, malaise, fatigue, frontal headache, low back pain, muscle cramps and occasionally blurred vision, nausea, and vomiting. Physical examination reveals fever, perspiration, dyspnea, rales throughout the chest, and tachycardia; in some instances there has been a reversible reduction in pulmonary vital capacity; there is usually leucocytosis, which may amount to 12,000-16,000/cmm. An attack usually subsides after 6 to 12 hours but may last for up to 24 hours; recovery is usually complete. Most workers develop an immunity to these attacks but it is quickly lost; attacks tend to be more severe on the first day of the work-week. Only freshly formed fume causes the illness, presumably because flocculation occurs in the air with formation of larger particles that are deposited in the upper respiratory tract and do not penetrate deeply into the lungs. Chills have been reported in workers from exposure to concentrations of zinc oxide fume below 5 mg/M3.

III. SIGNS AND SYMPTOMS

Sweet or metallic taste in the mouth; dryness and irritation of throat, dry cough, followed by substernal tightness, chills and fever, constriction in the chest, dyspnea, rales throughout the chest, reduction in pulmonary function; frontal headache; blurred vision; muscle cramps, low back pain; nausea, vomiting; lassitude, malaise, fatigue.

IV. SPECIAL TESTS

Determination of zinc in the urine of exposed workers is helpful in evaluating the extent of exposure, 0.6 to 0.7 mg of zinc per liter of urine have been found in workers exposed to zinc oxide fume in concentrations between 3 and 5 mg/M3.

V. TREATMENT

None specific. Remove from exposure and provide necessary supportive treatment. Recovery is usually complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Inhalation of zinc oxide fume causes metal fume fever, an illness similar to an acute attack of influenza. In a few cases, reversible reduction of pulmonary function has occurred. Recovery is usually complete within 24 hours and there are no sequelae. It is important that the physician become familiar with plant operating conditions in which exposure to zinc oxide fume occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. PREPLACEMENT

The following medical procedures must be made available to each employee who is exposed to zinc oxide fume:

1. A complete history and physical examination -- The purpose is to detect preexisting conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the respiratory system should be stressed.

2. 14" x 17" chest roentgenogram -- Zinc oxide fume may cause respiratory impairment. Persons with pulmonary disease may be more susceptible to the effects of zinc oxide fume. Surveillance of the lungs is indicated.

3. FVC and FEV (1 sec) -- Persons with preexisting pulmonary disease may be more susceptible to the effects of zinc oxide fume. Periodic surveillance is indicated.

C. PERIODIC EXAMINATIONS

The above medical examinations are to be repeated on an annual basis except that an x-ray is required only when indicated by pulmonary function testing.

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Zinc Oxide Fume," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, pp. 284-285.

2. Hygienic Guide Series: "Zinc Oxide," American Industrial Hygiene Association Journal, 30:422-424, 1969.

3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1182-1188.

4. Browning, Ethel: Toxicity of Industrial Metals (2d ed.), Butterworths, London, 1969, pp. 348-355.

5. Hamdi, E.A.: "Chronic Exposure to Zinc of Furnace Operators in a Brass Foundry," British Journal of Industrial Medicine, 26:126-134, 1969.

6. McCord, C.P.: "Metal Fume Fever As an Immunological Disease," Industrial Medicine and Surgery, 29:101-107, 1960.

7. Vallee, B.L.: "Zinc and Its Biological Significance," A.M.A. Archives of Industrial Health, 16:147-154, 1957.

8. Rohrs, L.C.: "Metal-Fume Fever from Inhaling Zinc Oxide," A.M.A. Archives of Industrial Health, 16:42-47, 1957.

9. National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare: Criteria for a recommended standard . . . . Occupational Exposure to Zinc Oxide, HEW Publication No. (NIOSH) 76-104, U.S. Government Printing Office, Washington, D.C., 1975.

10. Fishburn, C.W. aand C. Zenz: "Metal Fume Fever," Journal of Occupational Medicine, 11:142-144, 1969. zinc oxide fume in concentrations between 3 and 5 mg/M3.

REFERENCES AND SOURCES
ZINC OXIDE FUME
1910.93

(f) Personal Protective Equipment, and, (h) Sanitation

General: Turner, "An Occupational Dermatoconiosis Among Zinc Oxide Workers"

COMMENTS

General: A search of the literature failed to reveal information on the toxicity of zinc oxide fume on the eye or by ingestion. Inhalation of the freshly formed fume is documented to cause metal fume fever.

According to an excerpt from Turner, zinc oxide dust can act as a "mechanical conveyor of bacteria" by forcing body debris and bacteria, along with the oxide, into sebaceous glands. Perspiration and the rubbing of body surfaces aid the action. The resulting blockage of gland outlets and infection may cause a dermatitis." Turner points out that routine personal cleanliness will alleviate this condition.

The action described by Turner is not one which can be considered to be unique to zinc oxide or caused by any chemical or toxicological property of the substance. It is one which is possible in any situation in which workmen perspire, work in "dirty" conditions, and do not attend to their personal cleanliness. It is, therefore, concluded that none of the statements normally specified in this section are appropriate, especially since this standard is for the fume, and Turner discusses the actions of the dust. Where the "mechanical" action of a substance is involved, it can be theorized that the dust is more likely to penetrate the skin.

SUBSTANCE TECHNICAL GUIDELINES

Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 22, p. 609 (K-O)

"Lange's Handbook of Chemistry," 11th edition (Lange)

Sources of data items used:

I. A. 1. Synonyms: None
2. Formula: Lange
3. Molecular weight: Lange

B. 1. Boiling point: Perry's Chemical Engineers Handbook
2. Specific gravity: K-O
3. Vapor density: Not applicable
4. Melting point: Perry's Chemical Engineers Handbook
5. Vapor pressure: Not applicable
6. Solubility in water: K-O
7. Evaporation rate: Not applicable
8. Appearance and odor: ADL

II. A. 1. Flash point: Not applicable
2. Autoignition temperature: Not applicable
3. Flammable limits: Not applicable
4. Extinguishing media: Not applicable
5. Special fire fighting procedures: ADL

6. Unusual fire and explosion hazards: None

B. 1. Conditions contributing to instability: ADL
2. Incompatibilities: NFPA 491 M
3. Hazardous decomposition products: none
4. Special precautions: None

III. A. Steps if released or spilled: ADL

C. Waste disposal method: Not applicable

V. Miscellaneous precautions: ADL

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

"Documentation of Threshold Limit Values," American Conference of Government Industrial Hygienists, 1971 (ACGIH)

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References for Specific Use/Exposure

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2. AIHA, Stern, Hamdi, Penn
3. Stern, Origins, Hawley
4. Rohrs
5. AIHA, Origins, Hawley, CEH, K-O
6. Stern, Origins
7. Penn, Origins, Merck
8. Origins, Hawley, CEH, K-O, Merck
9. Hammond
10. Hawley

References for Specific Control Methods

AIHA, ACGIH and Penn were the references used in all of the Specific Control Methods.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Zinc oxide fume

D. O. L. STANDARD: 5 mg/M3

Eye Irritation Level: Zinc oxide fume is not known to be an eye irritant.

IDLH: There is no evidence in the available toxicological evidence that an acute exposure to a high concentration of zinc oxide fume would impede escape within one-half hour or cause any irreversible health effects. For the purposes of this standard, therefore, allowable respiratory protection has been determined on the basis of the protection factor afforded by each device. It is recognized, however, that for some substances for which there does not appear to exist a concentration immediately dangerous to life and health, the determination of allowable respiratory protection based on protection factors may result in the selection of a concentration which is not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only those respirators allowed for use above IDLH concentrati are permitted for use in concentrations exceeding 500 times the permissible exposure.

Other Toxicological Information: Browning reports that "Drinker distinguishes between the effects of zinc oxide powder, which has produced relatively little systemic disturbance, and the fumes of freshly burned zinc oxide, which he regards as specific to the incidence of chills and fever. These symptoms resemble those of an acute attack of influenza -- chills, aching, nausea and fever, dry throat and cough, weakness and lassitude . . . Recovery is usually rapid and there are no sequelae. Most workers develop an immunity to these attacks but it is quickly lost."

The AIHA Hygienic Guides state that "after initial response resulting in 'chills' often times much higher concentrations elicit no reaction. One subject inhaling a concentration of 52 mg/M3 zinc oxide in a brass foundry developed fever, but next day inhaled a concentration of 330 mg/M3 without fever. Another subject in an experimental chamber inhaled 430 mg/M3 for a few minutes, retaining about 23 mg. He developed a fever of 101.2 F but next day inhaled 610 mg/M3 retaining about 33 mg with only slight fever (99.5 F). On the third day both considered themselves to be in normal health. Workers in factories have noted that chills appear most frequently on Monday or the first day after holidays." According to the Hygienic Guides, the symptoms of zinc oxide poisoning frequently "occur four to five hours after breathing the fume and last for three to six hours." The Guides state that within 24 to 48 hours recovery is complete.

USE/EXPOSURE AND CONTROL DOCUMENT
ZINC OXIDE FUME

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of fume during the brazing, welding, burning or cutting of zinc and galvanized metals	A	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices)
2.	Inhalation of fume during the founding of brass, copper and zinc metals, and during the galvanizing of iron and steel	A	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices)
3.	Inhalation of fume during the production of zinc oxide by the oxidation of vaporized zinc (French process) or by the roasting of zinc and zinc oxide ores (American process)	A	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices)
4.	Inhalation of fume during the abrasive cleaning of galvanized metal surfaces	A	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices)
5.	Inhalation of fume during use as a ceramic flux	A	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices)
6.	Inhalation of fume during recovery from impure lead blast furnace slag	A	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices)
7.	Inhalation of fume during use in the manufacture of glass. Zinc oxide increases the brilliance	A	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equip-

	and luster of glass		ment (respiratory protective devices)
8.	Inhalation of fume during use as an intermediate in the manufacture of other zinc compounds	A	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices)
9.	Inhalation of fume during use of zinc as a filler material in the crushed stone industry	A	General dilution ventilation; personal protective equipment (respiratory protective devices)
10.	Inhalation of fume during use of zinc or galvanized metals in the manufacture of electronic devices	A	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices)

A -- Inhalation
B -- Skin and eye contact resulting in localized irritation
C -- Ingestion
D -- Skin contact resulting in absorption and subsequent systemic poisoning

------ JES2 JOB STATISTICS ------

1,050 CARDS READ

0 SYSOUT PRINT RECORDS

0 SYSOUT PUNCH RECORDS

0.00 MINUTES EXECUTION TIME