

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** MANGANESE ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for MANGANESE

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 MANGANESE.

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.

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(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of manganese not in excess of 10 parts per million (ppm) (5.0 milligrams per cubic meter (mg/m³) during over any eight-hour work shift, as stated in § 1910.1000, Table Z-1.

(2) "Action level" means one half of the permissible exposure for manganese averaged over an eight-hour work shift.

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

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

(i) Any information, observations, or calculation which may indicate employee exposure to manganese;

(ii) Any measurements of manganese taken;

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

(iv) Date of initial 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 manganese above the permissible exposure, 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 exposure of the employee.

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

(i) Identify all employees who may be exposed above the permissible exposure; and

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

(5) If an employee exposure measurement reveals that an employee is exposed to manganese above the permissible exposure, but not above the permissible exposure, the exposure of that employee shall be measured at least every three months.

(6) If an employee exposure measurement reveals that an employee is exposed to manganese 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 manganese 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 manganese 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.

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(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 (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 (Percent of True Value)
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 manganese above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of manganese 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 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 local exhaust is used to control exposure, measurements which demonstrate system effectiveness, for example the air velocity or static pressure, 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 manganese.

(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 not feasible; or

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

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(iv) For operations which require entry into tanks or closed vessels, tank and process sampling and gauging, and loading and unloading of tank vessels; or

(v) 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 MANGANESE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Dust or Mist Concentration	
25 mg/M3 or less	Any dust and mist respirator, except single use.
50 mg/M3 or less	Any dust and mist respirator, except single-use or quarter-mask respirators.
Dust, Mist, or Fume 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.
5000 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.
10,000 mg/M3 or less	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.

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Greater than 10,000 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. (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for manganese.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of manganese shall be Class II, Group E.

(3) For the purpose of compliance with § 1910.157, manganese is classified as a Class D fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of manganese shall be Class II, Group E.

(5) Sources of ignition such as smoking or open flames are prohibited where manganese presents a fire or explosion hazard.

(f) Personal Protective Equipment (reserved)

(g) Spills and disposal. (1) In the event that manganese is spilled the employer shall immediately provide available ventilation and then clean up the spill.

(2) Liquid manganese shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(h) Sanitation (reserved)

(i) Training and information. (1) Each employer who has a workplace in which manganese 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 manganese above the action level, without regard to the use of respirators or employees who work where a spill of manganese may occur, shall annually:

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

(ii) Advise affected employees as to the signs and symptoms of exposure to manganese.

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

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

(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) Preplacement medical examination. The employer shall make available to each employee who is exposed, or will be exposed, to airborne concentrations of manganese above the action level, without regard to the use of respirators, a preplacement medical examination which must include the following:

(i) A medical history and physical examination with emphasis on the lungs, kidneys, prostate and blood;

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

(iii) 14" x 17" chest roentgenogram;

(iv) Urinalysis to include specific gravity, albumin, glucose, a microscopic on centrifuged sediment and examination for specific low molecular weight proteins.

(3) Periodic medical examination. The employer shall make available to each employee exposed to airborne concentrations of manganese above the action level, without regard to the use of respirators, twelve months from the date of the employee's first exposure, and every twelve months thereafter, a periodic medical examination which must include the following:

(i) A medical history and physical examination with emphasis on the lungs, kidneys, prostate and blood;

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

(iii) A 14" x 17" chest roentgenogram, if pulmonary function tests show significant abnormalities;

(iv) Urinalysis to include specific gravity, albumin, glucose, a microscopic on centrifuged sediment and examination for specific low molecular weight proteins.

(4) Alternative medical procedures. If the examining physician chooses to use alternative medical procedures to those specified in paragraphs (j)(2) and (j)(3) of this section, the employer may accept such alternative medical procedures as meeting the requirements of this section provided that the employer:

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

(ii) Informs each exposed worker of the fact that alternative medical procedures to those required in paragraphs (j)(2) and (j)(3) of this section are to be made available.

(5) Interim medical examination. The employer shall provide an interim medical examination for the employee if the employee informs the employer of any of the signs or symptoms of exposure to manganese which are listed

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in Appendix A which the employee suspects are caused by exposure to manganese.

(6) Informing the physician. The employer shall provide to the physician performing any medical examination required by this section the following information:

- (i) A copy of this regulation with Appendixes A, B, and C for manganese;
- (ii) A description of the affected employee's duties as they relate to his exposure to manganese;
- (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 level; and
- (vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(7) Where a medical examination is required by paragraphs (j)(2), (j)(3), or (j)(5) of this section, following such examination the employer shall obtain from the examining physician a written opinion which conforms with paragraph (j)(8) of this section.

(8) Physician's written opinion. (i) The physician's written opinion by the examining physician shall specifically state:

(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 manganese;

(B) Any recommended limitations upon the employee's exposure to manganese, 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 the employee's employment.

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

(9) Results of tests. Where a preplacement or periodic medical examination is required by paragraphs (j)(2) or (j)(3) of this section, following such examination the employer shall obtain from the examining physician for inclusion in the employee's medical record:

(i) A recording of the results of the pulmonary function tests and the urinalysis;

(ii) The 14" x 17" chest roentgenogram when required, or a medically acceptable copy;

(iii) Where alternative medical procedures have been performed in accordance with paragraph (j)(4) of this section, a recording of such alternative procedures.

(10) No employee shall be exposed to manganese in such a way as would put the employee at increased risk of material impairment of his health from such exposure. The employer shall base this decision on any information available including the physician's written opinion.

(11) No medical procedure which would be performed pursuant to paragraphs (j)(2) or (j)(3) of this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

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(12) 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 risk involved by refusal to be examined.

(13) The employer shall provide emergency medical treatment for any employee injured through exposure to manganese.

(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 manganese.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to manganese which are being monitored;

(C) Sampling and analytical method used and evidence of their accuracy;

(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) The name and social security number of the employee;

(B) Results of tests required by paragraph (j)(2) and (j)(3) of this section and results of any tests conducted pursuant to paragraphs (j)(4) of this section;

(C) Any employee medical complaints relative to exposure to manganese;

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

(E) Physician's written opinion; and

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

(iii) This record shall be maintained for the duration of 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) Each employee or former employee shall have access to the exposure determination and exposure measurement records required to be maintained by this section which indicate his own exposure to manganese.

(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.

(1) Employee observation of measurement. (1) The employer shall give each employee or his representative an opportunity to observe any measurement of his exposure to manganese which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to manganese 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 manganese that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE: The information contained in the following appendix for manganese is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligations. To the extent that the information supplements this regulation for manganese, it is advisory in nature.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR MANGANESE

I. SUBSTANCE IDENTIFICATION

A. Substance: Manganese

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- B. Permissible Exposure: 5 milligrams of manganese per cubic meter of air (mg/m³) shall not be exceeded during any fifteen minute period during an eight-hour work shift.

C. Appearance: Gray solid

II. HEALTH HAZARD DATA

- A. Ways in which the chemical affects your body: Manganese can affect your body if you inhale it. Manganese can also affect your body if you swallow it.

- B. Effects of Overexposure:

1. Short-term Exposure: Inhalation of fumes with high concentrations of manganese and its oxides may bring about "metal fume fever". Symptoms of metal fume fever are chills and fever, upset stomach and vomiting, dryness of your throat, cough, weakness, and aching of your head and body. Symptoms often occur several hours after exposure to fumes and usually last for only a day.
2. Long-term Exposure: Prolonged or repeated exposure to manganese may affect the nervous system with difficulty in walking and balancing, weakness or cramps in your legs, hoarseness of your voice, trouble with your memory and judgment, unstable emotions or unusual irritability. If high exposure continues, you may have poor coordination, difficulty speaking clearly or shaking or tremor of your arms or legs. You may also have hallucinations or uncontrollable laughter or crying. Your respiratory systems may be affected by a condition known as "manganese pneumonia" which may result in symptoms and signs of coughing, fever or chills, general aching of the body, chest pain and other common signs of pneumonia.
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 manganese.

III. EMERGENCY FIRST AID PROCEDURES

- A. Breathing: If you or any other person breathes in large amounts of manganese 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. Swallowing: When manganese dust has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.
- C. 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 emergency rescue equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

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- A. Respirators: Respirators are not the best way to control exposure to manganese. 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: None required
- C. Eye Protection: None required

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. Manganese is a combustible solid. Its dust can form explosive mixtures with air.
- B. Sources of ignition such as smoking and open flames are prohibited wherever manganese is handled, used or stored in a manner that could create a potential fire or explosion hazard.
- C. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them.
- D. Ask your supervisor where manganese is used 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 manganese. In addition, your employer must instruct you in the safe use of manganese, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to manganese. 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 the actions which are being taken to reduce your exposure.
- C. Your employer is required to keep records of your exposure and medical examinations. Your employer is required to keep exposure data for at least one year and to keep medical data during your employment, and for a period of five years following your termination of employment. Your employer is required to make the exposure data available to you upon your request. Your employer is also required to release your medical records to your physician upon your written request.
- D. Your employer must give you a copy of the physicians written opinion for any physical examination required by this standard.

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APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
FOR MANGANESE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: None
2. Formula: Mn
3. Molecular weight: 54.94

B. Physical Data

1. Boiling point (760 mm Hg): 2097 C (3806 F)
2. Specific gravity (water = 1): 7.2
3. Vapor density: Not available
4. Melting point: 1245 C (2273 F)
5. Vapor pressure at 1227 C (2240 F): 1 mm Hg
6. Solubility in water, grams of manganese per 100 grams of water at 20 C (68 F):
7. Evaporation rate (butyl acetate = 1):
8. Appearance and odor: gray solid

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: data not available
2. Autoignition temperature: data not available
3. Flammable limits in air, % by volume: data not available
4. Extinguishing media: data not available
5. Special fire-fighting procedures: Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Manganese is a combustible solid. Ignition sources must be controlled where manganese is used, handled or stored in a manner that could create a potential fire or explosion hazard.
7. For purposes of complying with the requirements of 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for manganese shall be Class II, Group E.

III. SPILL AND DISPOSAL PROCEDURES

A. If manganese is spilled, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, sweep onto paper or other suitable material then burn the paper. Large quantities can be

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collected and reclaimed or atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

- B. Persons not wearing protective equipment should be restricted from areas of spills until cleanup has been completed.
- C. Waste disposal methods: Manganese may be disposed of: 1) by making packages of manganese in paper or other flammable material and burning in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device; 2) by dissolving manganese in a flammable solvent (such as alcohol) and atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. EXPOSURE ABOVE THE ACTION LEVEL:

1. Measurements taken for the purpose of determining employee exposure under this section are best taken such that the eight-hour exposure may be determined from a single eight-hour sample or two four-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). The sampling and analysis under this section 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 particulates using a high efficiency membraned filter with subsequent chemical analyses. The method of measurement must determine the concentration of manganese to plus or minus 35%.
2. Ceiling Evaluation: Measurements taken for the purpose of determining employee exposure under this section must be taken during periods of maximum expected airborne concentrations of manganese in the employee's breathing zone. A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

- B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring and measurements under this section should be essentially the same as described under paragraph IV. A. When sampling for peak or ceiling exposure evaluations, more than three (3) measurements should be taken during the work shift so that increased confidence may be placed in the judgement that the employee has or has not, in fact, been exposed in excess of the permissible limit. 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 of manganese to plus or minus 25%.

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- 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 A" (Order number PB245850/AS).
- 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. Store manganese in tightly closed containers in a cool, well ventilated area.
- B. Employers should advise employees of all areas and operations where their exposure to manganese could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to manganese is likely to occur are: During its use in the steel industry.

NOTE: The information contained in the following appendix for manganese is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligations. To the extent the information supplements this regulation for manganese, it is advisory in nature.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation

II. TOXICOLOGY

Inhalation of manganese dust or fume primarily affects the central nervous system; high concentrations cause the influenza-like illness termed manganese pneumonitis. Manganese acts either as a direct neurotoxin, or it adversely affects certain neuroenzymes. Manganese fume causes a disease quite similar to Parkinsonism after 6 months to 2 years of exposure. Initially there is headache; asthenia; restless sleep or somnolence; change in personality with psychomotor instability associated with restlessness, irritability, and a tendency to either cry or laugh inappropriately. This is followed by an intermediate phase with visual hallucinations, double vision; impaired hearing; uncontrollable impulses; mental confusion; euphoria; and normal reaction to painful stimuli. In the advanced phase, the subject exhibits possible anemia; excessive salivation; disorders of the basal ganglia of Parkinsonian type, such as mask-

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like facies, muscle weakness, muscle rigidity, tremor of the upper extremities and head, and impaired gait. High concentrations of manganese dust produce fever and chills similar to metal fume fever. During human exposure to manganese fume there is dryness and irritation of the throat, a sweet or metallic taste followed by substernal tightness, 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. Leukopenia has been reported in 4 out of 16 cases of manganese poisoning, although there is no convincing evidence that any changes in the blood should be regarded as specific or diagnostic of manganism.

III. SIGNS AND SYMPTOMS

Parkinson's syndrome which include headache; asthenia, difficulty in walking and instability; irritability; sleeplessness; spasmodic laughter and crying; mental confusion, aggressiveness or hallucinations; cramps and tremors. Metal fume fever which includes sweet or metallic taste in the mouth; dryness and irritation of throat, dry cough; substernal tightness, constriction in the chest, dyspnea, rales throughout the chest, reduction in pulmonary function; frontal headache; blurred vision; fever, perspiration, chills; muscle cramps, low back pain; nausea, vomiting; lassitude, malaise, fatigue.

IV. SPECIAL TESTS

Determination of manganese in the urine of exposed workers is helpful in evaluating the extent of exposure.

V. TREATMENT

Remove from exposure. Promptly flush eyes with water and wash skin with soap or mild detergent and water. Give artificial resuscitation and administer oxygen if indicated. Administration of EDTA or EDTA-type compounds may be useful in mobilizing manganese from the tissues, but the accelerated urinary excretion of manganese is of uncertain effect upon the neurologic damage produced by the metal.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Inhalation of manganese fume and dust causes a central nervous system disorder similar to Parkinson's disease, as well as metal fume fever which is similar to an acute attack of influenza. It is important that the physician become

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familiar with plant operating conditions in which exposure to manganese 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 manganese:

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. Persons with a history of alcoholism, psychiatric, neurologic, or pulmonary diseases or liver dysfunction would be expected to be at increased risk from exposure. Examination of the respiratory tract, hemopoietic system and kidneys should be stressed.
2. 14" x 17" chest roentgenogram -- Manganese causes pneumonitis or metal fume fever. Surveillance of the lungs is indicated.
3. FVC and FEV (1 sec) -- Manganese is reported to cause decreased pulmonary function. Periodic surveillance is indicated.
4. A complete blood count -- Manganese has been reported to cause blood changes. A complete blood count must be performed including a red cell count, a white cell count, a differential count of a stained smear, as well as hemoglobin and hematocrit.
5. Urinalysis -- Since kidney damage has been observed in humans exposed to manganese, a urinalysis shall be obtained to include, at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

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 the results of pulmonary function testing, or by signs and symptoms of respiratory disease.

VII. REFERENCES

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USE/EXPOSURE AND CONTROL DOCUMENT

MANGANESE
Principal Route
of Entry

Use/Exposure

Currently Used
Control Methods

1.	Release of fume during welding operations	A	Local exhaust ventilation; respiratory protective devices; dilution ventilation
2.	Release of fume during casting of molten ferro-manganese	A	Local exhaust ventilation
3.	Release of fume during pigging operations	A	Local exhaust ventilation
4.	Release of dust during bagging of manganese ore	A	Local exhaust ventilation; respiratory protective devices; dust suppression with water
5.	Release of dust during mixing and pressing of dry battery depolarization	A	Local exhaust ventilation
6.	Release of dust during grinding of ore containing manganese	A	Process enclosure; local exhaust ventilation; dust suppression with water
7.	Release of fume during arc burning of manganese hardened steel in repair and manufacture programs	A	Local exhaust ventilation; respiratory protective devices; dilution ventilation
8.	Release of fume from top of submerged arc electric furnace	A	General dilution ventilation and process enclosure, if feasible
9.	Release of dust during ore extraction	A	General dilution ventilation; respiratory protective devices
10.	Release of dust during metal finishing operations of high manganese steel	A	Local exhaust ventilation; respiratory protective devices
11.	Release of dust during crushing of ferro-manganese prior to shipment	A	Local exhaust ventilation; respiratory protective devices
12.	Release of dust during dumping, weighing, and mixing operations in ceramics and glass manu-	A	Local exhaust ventilation; respiratory protective devices

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facture for pigmentation
and coloration purposes

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| 13. | Release of dust during
formulation of proprietary
mixtures for paint and
varnish manufacturers | A | Local exhaust ventilatio
respiratory protective d |
| 14. | Release of dioxide and
sulfate during manufacture
and application of
fertilizers | A | Local exhaust ventilatio |
| 15. | Release of dust during
manufacture of manganese,
soap and wood preservatives | A | Local exhaust ventilatio |
| 16. | Release of dust during
manufacture of safety matches,
signal flares, fireworks, and
strickers | A | Local exhaust ventilatio |
| 17. | Release of dust during
mixing and kiln operations
of brick manufacture | A | Local exhaust ventilatio |
| 18. | Release of dust during
manufacture and utilization
of oxidation catalysts, such
as hopcalite, manganese
acetate, and naphthenate | A | Local exhaust ventilatio |

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