NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND

SUPPORTING DOCUMENTATION FOR

*** CYANIDE AS CN ***

NIOSH/OSHA Draft Technical Standard and Supporting Documentation for CYANIDE AS CN

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 CYANIDE AS CN.

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 cyanide (as CN) 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 cyanide averaged over an eight-hour work shift.

(3) Cyanide means the alkali salts of cyanide (lithium, sodium, potassium, cesium).

(b) Initial determination and exposure measurement. (1) Each employer who has a place of employment in which cyanide is released into the workplace air shall determine if there is any possibility that any employee may be exposed to airborne concentrations of cyanide above the permissible level. 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 cyanide.

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

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

(ii) Any measurements of cyanide taken;

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

(iv) Date of initial determination, work being performed at the time, location within work site, and employees considered.

(3) If the employer determines that any employee may be exposed to cyanide 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 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 cyanide above the action level, the employer shall:

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

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

(5) If an employee exposure measurement reveals that an employee is exposed to cyanide above the action level, 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 cyanide 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 cyanide above the permissible exposure. The employee shall also be notified of the results of the exposure measurements and of the corrective action being taken to reduce the exposure to permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to cyanide 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 cyanide above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of cyanide 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, 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 cyanide.

(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 cyanide to at or below the permissible exposure; or

(iv) For operations which require entry into tanks or closed 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. When an employee informs his employer that he is experiencing eye irritation from cyanide while wearing a respirator allowed in Table 2, the employer shall provide and ensure that the employee use an equivalent respirator with a full facepiece, helmet or hood.

TABLE 2 RESPIRATORY PROTECTION FOR CYANIDE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Particulate Concentration	
50 mg/M3 or less	Any supplied-air respirator. Any self-contained breathing apparatus.
Greater than 50 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.
Escape	Any gas mask providing protection against hydrogen cyanide and particulates. Any escape self-contained breathing apparatus.

(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 cyanide.

(2) Cyanide shall be stored so as not to come in contact with potassium, sodium, strong oxidizers (such as nitrates and chlorates), acids and acid salts.

(f) Personal protective equipment. (1) Employers shall provide and ensure that employees use appropriate protective clothing and equipment necessary to prevent any possibility of skin contact with cyanide or

liquids containing cyanide. Face shields shall comply with § 1910.133 (a)(2), (a)(4),(a)(5), and (a)(6).

(2) Employers shall ensure that employees whose clothing has had any possibility of being contaminated with cyanide change into uncontaminated clothing before leaving the work premises.

(3) Employers shall ensure that clothing which has had any possibility of being contaminated with cyanide is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of cyanide from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the cyanide, the employer shall inform the person performing the operation of the hazardous properties of cyanide.

(4) Where there is any possibility of exposure of an employee's body to cyanide or liquids containing cyanide, employers shall provide facilities for quick drenching of the body within the immediate work area for emergency use.

(5) Employers shall ensure that non-impervious clothing which becomes contaminated with cyanide be removed immediately and not reworn until the cyanide is removed from the clothing.

(6) Employers shall provide and ensure that employees use safety goggles which comply with § 1910.133 (a)(2)-(a)(6) where there is any possibility of cyanide or liquids containing cyanide contacting the eyes.

(7) Where there is any possibility that an employee's eyes may be exposed to cyanide or liquids containing cyanide, employers shall provide an eye-wash fountain within the immediate work area for emergency use.

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

(h) Sanitation. (1) Employers shall ensure that employees whose skin becomes contaminated with cyanide immediately wash or shower with soap or mild detergent and water to remove any cyanide from the skin.

(2) Employers shall ensure that all employees subject to skin contact with cyanide wash with soap or mild detergent and water any areas of the body which may have contacted cyanide at the end of each work day.

(3) Employers shall ensure that employees do not eat or smoke in areas where cyanide or liquids containing cyanide are handled, processed or stored.

(4) Employers shall ensure that employees who handle cyanide or liquids containing cyanide wash their hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.

(i) Training and information. (1) Each employer who has a workplace in which cyanide 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 cyanide above the action level without regard to the use of respirators, or employees who may have any possibility of skin or eye contact with cyanide or liquids containing cyanide, or employees who work where a spill of cyanide may occur, shall annually:

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

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

(iii) Instruct affected employees to advise the employer of the development of signs and symptoms of overexposure to cyanide 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 cyanide.

(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 cyanide above the action level, without regard to the use of respirators, or employees who may have any possibility of skin or eye contact with cyanide or liquids containing cyanide a preplacement medical examination which must include a medical history and physical examination with emphasis on the heart, nervous system, liver, kidneys and skin.

(3) Periodic medical examination. The employer shall make available to each employee exposed to airborne concentrations of cyanide above the action level, without regard to the use of respirators, or employees who may have any possibility of skin or eye contact with cyanide or liquids containing cyanide twelve months from the date of the employee's first exposure, and every twelve months thereafter, a periodic medical examination which must include a medical history and physical examination with emphasis on the heart, nervous system, liver, kidneys, and skin.

(4) 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 cyanide which are listed in Appendix A which the employee suspects are caused by exposure to cyanide.

(5) 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 cyanide;

(ii) A description of the affected employee's duties as they relate to his exposure to cyanide;

(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.

(6) Where a medical examination is required by paragraphs (j)(2), (j)(3), or (j)(4) of this section, following such examination the employer shall obtain from the examining physician a written opinion which conforms with paragraph (j)(7) of this section.

(7) 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 cyanide;

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

(8) No employee shall be exposed to cyanide 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.

(9) 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.

(10) 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.

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

(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 cyanide.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to cyanide 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 cyanide;
(D) A copy of information provided to the physician pursuant to paragraph (j)(5)(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 cyanide.
(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 each employee or his representative an opportunity to observe any measurement of his exposure to cyanide which is conducted pursuant to this section.
(2) When observation of measurement of employee exposure to cyanide 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 cyanide that are being performed at the place of exposure; and
(iii) Record the results obtained.

NOTE: The information contained in the following appendix for cyanide is neither intended, by itself, to create any additional obligations not

otherwise imposed, nor detract from any existing obligation. To the extent that the information supplements this regulation for cyanide, it is advisory in nature.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET FOR CYANIDE

I. SUBSTANCE IDENTIFICATION

A. Substance: Cyanide (as CN)

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

C. Appearance and Odor: Potassium cyanide: White solid with a faint almond odor; Sodium cyanide: White solid with a faint almond odor

II. HEALTH HAZARD DATA

A. Comments: Cyanide may be rapidly fatal. Immediate first aid may be lifesaving.

B. Ways in which the chemical affects your body: Cyanide can affect your body if you inhale it or if it comes in contact with your eyes or skin or if you swallow it. It may enter your body through your skin.

C. Effects of Overexposure:

1. Short-term Exposure: Inhalation or ingestion of cyanide salts may be rapidly fatal. Larger doses by inhalation or swallowing may cause the person to rapidly lose consciousness, stop breathing and die. In some cases there are convulsions. At lower levels of exposure the earlier symptoms include weakness, headache, confusion, nausea and vomiting. These symptoms may be followed by unconsciousness and death. Occasionally, convulsions occur. Milder forms of intoxication may result only in weakness, dizziness, headache and nausea. The dust of cyanide salts is irritating to the eyes. In the presence of tears it may cause the symptoms of poisoning described above. The dust of cyanide salts may produce irritation of the nose and skin. Strong solutions of cyandie salts are corrosive and may produce ulcers. Sufficient cyanide may be absorbed through the skin, especially if there are cuts to cause fatal poisoning.

2. Long-term Exposure: Not 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 cyanide.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If cyanide gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower

and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If cyanide gets on your skin, immediately wash the contaminated skin with soap or mild detergent and water. If cyanide penetrates your clothing, remove the clothing immediately and wash the skin with soap or mild detergent and water. Get medical attention immediately.

C. Breathing: If you or any other person breathes in large amounts of cyanide 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.

D. Swallowing: When cyanide has been swallowed, 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.

E. 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.

F. Special First Aid Procedures: First aid kits containing an adequate supply of amyl nitrite pearls (ampules) will be maintained at each site where cyanide is used. When a person is suspected of receiving an overexposure of cyanide, immediately remove him from the contaminated area using established rescue procedures. Contaminated clothing must be removed and cyanide washed from the skin immediately. Artificial resuscitation should be started at once if breathing has stopped. If the person is unconscious a pearl of amyl nitrite wrapped in a handkerchief should be broken and held about one inch from the patient's mouth and nostrils for 15 seconds. Repeat five times at 15 second intervals. Use a fresh pearl every five minutes until three or four pearls have been administered. Keep a record of the number of pearls used. (Rescuers should keep the open pearls away from their own mouths and noses so they do not become weak or dizzy.) If the patient has stopped breathing and artificial resuscitation is being used, methods other than mouth-to-mouth resuscitation must be used during the period when the amyl nitrite pearls are being administered. Medical aid should be obtained immediately.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: Respirators are not the best way to control exposure to cyanide. 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 can smell cyanide while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: You must wear appropriate protective clothing and equipment to prevent any possibility of skin contact with cyanide or liquids containing cyanide. Replace or repair impervious clothing that has developed leaks.

C. Eye Protection: You must wear splash-proof safety goggles where there is any possibility of liquids containing cyanide contacting your eyes. You must wear dust-resistant safety goggles where there is any possibility of solid cyanide contacting your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

A. Cyanide must be stored in tightly closed containers in a cool, well ventilated area away from potassium, sodium, strong oxidizers (such as nitrates and chlorates), acids and acid salts.

B. If your work clothing has had any possibility of being contaminated with solid cyanide, you must change into uncontaminated clothing before leaving the work premises.

C. You must immediately remove any non-impervious clothing that becomes contaminated with cyanide and this clothing must not be reworn until the cyanide is removed from the clothing.

D. If your skin becomes contaminated with cyanide, you must immediately wash or shower with soap or mild detergent and water to remove the cyanide from your skin.

E. If you are subject to skin contact with cyanide, at the end of each work day you must wash with soap or mild detergent and water any areas of your body that may have contacted cyanide.

F. You must not eat or smoke in areas where cyanide or liquids containing cyanide are handled, processed or stored.

G. If you handle cyanide or liquids containing cyanide, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.

H. Eye flushing facilities and quick drenching facilities, where provided, must be readily available and you should know where they are and how to operate them.

I. Ask your supervisor where cyanide 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 cyanide. In addition, your employer must instruct you in the

safe use of cyanide, emergency procedures, and the correct use of protective equipment.

B. Your employer is required to determine whether you are being exposed to cyanide. 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 uour 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.

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

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES FOR CYANIDE

(The standard for cyanide should not be interpreted to only apply to the exampl compounds listed below for which substance specific information has been provi

I. PHYSICAL AND CHEMICAL DATA (Potassium cyanide)

A. Substance Identification

1. Synonyms: None
2. Formula: KCN
3. Molecular Weight: 65.1

B. Physical Data

1. Boiling point (760 mm Hg): Data not available
2. Specific gravity (water = 1): 1.55
3. Vapor density (air = 1 at boiling point of potassium cyanide Not applicable
4. Melting point: 635 C (1175 F)

5. Vapor pressure at 20 C (68 F): Essentially zero
6. Solubility in water, % by weight at 20 C (68 F): 71.6
7. Evaporation rate (butyl acetate = 1): Not applicable
8. Appearance and odor: White solid with a faint almond odor

II. PHYSICAL AND CHEMICAL DATA (Sodium cyanide)

A. Substance Identification

1. Synonyms: None
2. Formula: NaCN
3. Molecular weight: 49

B. Physical Data

1. Boiling point (760 mm Hg): 1500 C (2732 F) (extrapolated)
2. Specific gravity (water = 1): 1.6
3. Vapor density (air = 1 at boiling point of sodium cyanide): Not applicable
4. Melting point: 560 C (1040 F)
5. Vapor pressure at 20 C (68 F): Essentially zero
6. Solubility in water, % by weight at 20 C (68 F): 58
7. Evaporation rate (butyl acetate = 1): Not applicable
8. Appearance and odor: White solid with a faint almond odor

III. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA (Potassium Cyanide and Sodium

A. Fire

1. Not combustible

B. Reactivity

1. Conditions contributing to instability: None. Hazardous if kept in closed containers. May form toxic concentrations of hydrogen cyanide gas when in prolonged contact with air in a closed area.
2. Incompatibilites: Contact with strong oxidizers such as nitrates and chlorates may cause fires and explosions. Contact with acids and acid salts causes immediate formation of toxic and flammable hydrogen cyanide gas.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen cyanide and carbon monoxide) may be released when cyanide decomposes.
4. Special precautions: Cyanide may react with carbon dioxide in ordinary air to form toxic hydrogen cyanide gas.

IV. SPILL AND DISPOSAL PROCEDURES

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

1. Ventilate area of spill.
2. Collect spilled material in the most convenient and safe manner for reclamation, or for treatment with caustic in chlorine or one of chlorines alkaline compounds.

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

C. Waste disposal methods: After treatment as in (A) above, cyanide may be disposed of in a secured sanitary landfill.

V. 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 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). 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 particulates using a high efficiency membrane filter with subsequent chemical analysis. The method of measurement must determine the concentration of cyanide 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 of cyanide 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 R" (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.

VI. MISCELLANEOUS PRECAUTIONS

A. Store cyanide in a well ventilated area.

B. Employers should advise employees of all areas and operations where their exposure to cyanide could occur.

VII. COMMON OPERATIONS

Common operations in which exposure to cyanide is likely to occur are: During its production and its use in electroplating solutions; as a case hardening agent for metals; for the extraction of silver and gold from their ores; as an intermediate in the manufacture of dyes, pigments, and nitrilotriacetic acid; as a fumigant and pesticide; and as an ingredient in fertilizer.

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

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for CYANIDE AS CN

I. ROUTE OF ENTRY

Inhalation; skin absorption; ingestion.

II. TOXICOLOGY

The dust of cyanide salts, a source of cyanide ion, is an asphyxiant due to an inhibitory action on metabolic enzyme systems and can be rapidly fatal. Cyanide exerts this effect because it inactivates certain enzymes by forming very stable complexes with the metal in them. Cytochrome oxidase is probably the most important of these since it occupies a fundamental position in the respiratory process and is involved in the ultimate electron transfer to molecular oxygen. Since cytochrome oxidase is present in practically all cells that function under aerobic conditions, and since the cyanide ion diffuses easily to all parts of the body, it is capable of suddenly bringing to a halt practically all cellular respiration. In the presence of even weak acids, hydrocyanic acid (HCN) gas is liberated from cyanide salts; a few inhalations of higher concentrations of HCN may be followed by almost instantaneous collapse and cessation of respiration; 270 ppm HCN is immediately fatal to humans, 181 ppm is fatal after 10 minutes, 135 ppm after 30 minutes, and 110 ppm may be fatal in 1 hour. The ingestion by humans of 50 to 100 mg of sodium or potassium cyanide may also be fatal. At lower levels of exposure to HCN, the earliest symptoms of intoxication may include weakness, headache, confusion, and occasionally nausea and vomiting; respiratory rate and depth is usually increased initially and at later stages becomes slow and gasping; if cyanosis is present, it usually indicates that respiration has either ceased or has been very inadequate for a few minutes. Humans tolerate 45 to 54 ppm for 1/2 to 1 hour without immediate or delayed effects, while 18 to 36 ppm may result in some symptoms after an exposure of several hours. Sodium cyanide dust is irritating to the eyes; in the presence of tears it may liberate HCN which can be absorbed and cause systemic intoxication. Skin contact with dust may be irritating; strong solutions on the skin produce ulcers which are slow in healing.

Cyanide is one of the few toxic materials for which an antidote exists, and functions as follows. First, amyl nitrite (inhalation) and sodium nitrite (intravenously) are administered to form methemoglobin, which binds firmly with free cyanide ions. This traps any circulating cyanide ions. The formation of 10 or 20 percent methemoglobin usually does not involve appreciable risk, yet provides a large amount of cyanide-binding substance. Second, sodium thiosulfate is administered intravenously to increase the rate of conversion of cyanide to the less toxic thiocyanate. Methylene blue should not be administered, because it is a poor methemoglobin former and, moreover, promotes the conversion of methemoglobin back to hemoglobin.

III. SIGNS AND SYMPTOMS

Asphyxia and death can occur from high exposure levels, while weakness, headache, confusion, nausea, vomiting result from lesser exposures; increased rate and depth of respiration, slow and gasping respiration; eye and skin irritation.

IV. SPECIAL TESTS

Determination of cyanide ion in the blood is useful in following the course of acute intoxication.

V. TREATMENT

Preparedness and speed of action are prerequisites for successful treatment for any overexposure to cyanide. All persons working with or around cyanides should be given specific detailed instructions on the use of antidote kits containing amyl nitrite pearls for immediate inhalation. Kits containing sterile sodium nitrite and sodium thiosulfate solutions with means for intravenous administration should be provided for use by medical personnel. These kits should be provided in suitable work locations. Any exposed individual should be removed as rapidly as possible to an uncontaminated area by adequately protected personnel. The following actions should be performed immediately in the following order: Administer artificial respiration if breathing has stopped; give amyl nitrite inhalations and sodium nitrite injection promptly, followed by sodium thiosulfate injection; remove clothing and bathe thoroughly with copious amounts of running water if skin contact has occurred; scrub hands and feet thoroughly; clean finger and toe nails. If cyanide salts have been swallowed and the person is conscious, induce vomiting. Consideration should be given to hospitalization and observation for 24 to 48 hours. If the signs of intoxication reappear or recovery is slow, the injection of sodium nitrite and sodium thiosulfate should be repeated. A patient who has received this antidotal treatment should not be treated with methylene blue.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Exposure to cyanide may be rapidly fatal. Sufficient skin absorption of sodium cyanide to cause poisoning is not well documented. However, in the presence of sweat, which is usually acidic, it may react to form HCN which is readily absorbed through the skin and could produce cyanide intoxication. It is important that the physician become familiar with plant operating conditions in which exposure to cyanide 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 cyanide:

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 fainting spells, such as occur in various types of cardiovascular and nervous disorders, those unusually susceptible to effects of anoxia or with anemia would be expected to be at increased risk from exposure. Examination of the cardiovascular system, nervous system, liver and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

C. PERIODIC EXAMINATIONS

The above medical examinations are to be repeated on an annual basis.

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Cyanides (as CN)," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 64.

2. Hygienic Guide Series: "Hydrogen Cyanide," American Industrial Hygiene Association Journal, 31:116-119, 1970.

3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1991-2001.

4. Manufacturing Chemists Association, Inc.: Chemical Safety Data Sheet SD-30, Sodium Cyanide, Washington, D.C., 1967, pp. 5, 15-18.

5. Chen, K.K. and C.L. Rose: "Nitrite and Thiosulfate Therapy in Cyanide Poisoning," Journal of the American Medical Association, 149:113-119, 1952.

6. Wolfsie, J.H.: "Treatment of Cyanide Poisoning in Industry," A.M.A. Archives of Industrial Hygiene and Occupational Medicine, 4:417-425, 1951.

REFERENCES AND SOURCES
CYANIDE
1910.1000

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

Eye: Grant, "Toxicology of the Eye;" Manufacturing Chemists' Association, "Chemical Safety Data Sheets;" Baskin, "Handling Guide for Potentially Hazardous Commodities;" Gleason, "Clinical Toxicology of Commercial Products"

Skin: Stauden, "Kirk-Othmer Encyclopedia of Chemical Technology," 2nd edition; Stecher, "The Merck Index," eighth edition; Gleason, "Clinical Toxicology of Commercial Products;" Hunter, "The Diseases of Occupations," 4th edition; Sax, "Dangerous Properties of Industrial Materials;" von Oettingen, "Poisoning;" Deichmann and Gerarde, "Toxicology of Drugs and Chemicals;" Patty, "Industrial Hygiene and Toxicology;" Baskin, "Handling Guide for Potentially Hazardous Commodities;" Hamilton and Hardy, "Industrial Toxicology"

Ingestion: Gleason, "Clinical Toxicology of Commercial Products;" Thienes and Haley, "Clinical Toxicology;" Patty, "Industrial Hygiene and Toxicology;" Stauden, "Kirk-Othmer Encyclopedia of Chemical Technology;" Stecher, "The Merck Index," eighth edition; Hamilton and Hardy, "Industrial Toxicology"

COMMENTS

Eye - Classifications: 1 and 5
Output statement numbers: 9 and 11 combined, 13
Exceptions: None

Grant has "applied 10% potassium cyanide neutralized with acetic acid to the eye of a guinea pig, and found no injury discernible by slit-lamp or testing by fluorescein."

The MCA and Baskin, however, have stated that sodium and cuprous cyanide, in contact with the tears of the eye, liberate cyanide ion which can be absorbed and cause systemic injuries. Indeed, this is most probably true for all the inorganic alkali salts. They have also stated that the salts may be damaging to the eye due to the corrosive effects on eye tissue.

Gleason has reported that "poisoning may arise from any substance which releases the cyanide ion."

Cyanides as CN are, therefore, concluded to warrant classifications of 1 and 5.

Skin - Classifications: 1 and 5
Output statement numbers: 1, 5a, 6, 8a, 14g, 14i, 15, 20a
Exceptions: None

Stauden reports that "the cyanides are true protoplasmic poisons, combining in the tissues with the enzymes associated with cellular oxidation and causing death through asphyxia."

All alkali salts of cyanide, according to Stecher, are "qualitatively and quantitatively similar to HCN in proportion to the CN content," causing "tachypnea, then dyspnea, paralysis, unconsciousness, convulsions and respiratory arrest."

Gleason notes that "poisoning may arise from any substance which releases the cyanide ion. Cyanide is a potent and

rapidly acting chemical asphyxiant: it deprives tissues of necessary oxygen by inhibiting reversibly such oxidative enzymes as cytochrome oxidase. Because oxygen cannot be utilized, venous blood retains the bright red color of oxy-hemoglobin." "The critical organs are those which are most sensitive to oxygen lack, notably the brain. A transient stage of central nervous stimulation is followed by central nervous depression and finally hypoxic convulsions and death due to respiratory arrest." Hunter further adds that "the cyanide ion is responsible for the toxic action, and this effect is, therefore, shared by all the soluble inorganic salts."

According to Sax, "workers . . . who are daily exposed to cyanide solutions may develop a 'cyanide' rash, characterized by itching, and by macular, papular, and vesicular eruptions. Frequently there is secondary infection."

von Oettingen reports that the "salts of hydrocyanic acid . . . may give rise to acute and subacute poisonings. Workers handling cyanides may develop a rash which is first located around the wrists, hands, and fingers, associated with moderate desquamation and itching, which later on may spread to all regions of the body, but which is most marked in those sections which are exposed to friction. Presumably it is due to the alkalinity of the cyanides. In acute poisonings the skin may be of a pink color. The question as to whether or not there exists a chronic cyanide poisoning is still open to discussion. Some observers believe in its existence and claim that nervousness, headache, vertigo, asthenia, diminution of tendon reflexes, and cutaneous hyperesthesia are the sequelae of continued exposure to cyanide dust and that in such patients dermatoses are not infrequent, ulcerations less frequent, and acne iosacea is rarely seen."

Deichmann and Gerarde say that "vomiting, convulsions and unconsciousness occur promptly after . . . skin absorption of sodium or potassium cyanide."

The MCA reports, "sodium cyanide is a white solid which is extremely poisonous . . . by contact with the skin. In strong solution it is also corrosive to the skin." In the "presence of sweat which is usually acidic, it may react to form hydrogen cyanide which is readily absorbed through the skin" and can "produce cyanide intoxication."

Patty refers to the toxic effect of calcium cyanamide as "principally that of a transient vasomotor disturbance of the upper portion of the body. Irritation of the exposed . . . skin can occur" also.

Baskin reports that cuprous cyanide, on contact with the skin in "higher concentrations produce ulcers which resist healing. In severe exposures, sufficient absorption may occur to produce "systemic injury." Calcium cyanide, upon "severe exposure causes immediate unconsciousness, convulsions, death within 15 minutes. Less severe exposure . . . by absorption through the skin causes dizziness, rapid breathing rat

headache, drowsiness, drop in blood pressure, rapid pulse, unconsciousness. Convulsions and death may occur within 4 hours after exposure."

According to Hamilton and Hardy, "dermatitis is a familiar occurrence in workers chronically exposed to cyanide solutions. The effect is considered to be due to the fact that the solution is strongly irritating and in some individuals causes severe itching. Occasionally a blotchy eruption of the face may follow low-level . . . solutions of cyanide salts. Cyanide rash is described as consisting usually of itching areas and papules and vesicles."

Hamilton and Hardy further note that Collins and Martland reported a case of an Italian worker who dropped silver into a solution of potassium cyanide to polish it. "He had severe pruritus and brownish-red pigmentation of the forearms."

Kirk-Othmer reports "normal skin absorbs HCN slowly. However, 2% HCN in air will cause poisoning in 3 min., 1% is dangerous in 10 min., and 0.5% may produce symptoms after 30 min., even though a gas mask or air helmet is worn. Cuts and abrasions absorb HCN rapidly and 50 - 60 mg absorbed through the skin is known to be fatal."

Hunter reports that during the "elutriation of gold," potassium cyanide solutions are employed. "If a man . . . has the slightest abrasion of the epidermis, ulceration which heals only very slowly will occur."

It is evident that absorption through the skin of these compounds may rapidly produce systemic poisoning. It is also evident that some strong solutions are corrosive to the skin. Classifications of 1 and 5 are, therefore, concluded to be most appropriate.

Ingestion - Classification: 1 and 5
Output statement numbers: 5a, 19, 20a
Exceptions: None

Gleason reports that the "alkali salts are usually toxic only when ingested. The average lethal dose of HCN taken by mouth is believed to lie between 60 and 90 mg (1 to 1 1/2 grains) this corresponds to about 1 teaspoon of a 2 per cent solution of hydrocyanic acid and to about 200 mg of potassium cyanide."

Thienes and Haley say that "even though recovery from acute poisoning may seem complete, there may be changes in personality several days to months later, and at autopsy degeneration of nerve cells may be found in the central nervous system." They also report "the average fatal dose of sodium or potassium cyanide is about 0.25 gm. However, one-fourth this amount has caused death. In the upper alimentary tract, especially the stomach, the cyanide salts are corrosive; after absorption, the cyanide radical inactivates certain oxidative enzymes of all tissues, particularly cytochrome oxidase by combining with its ferric heme group. This inactivation of enzymes prevents tissue utilization of oxygen carried by the blood. Chronic exposure to cyanide may cause goiter

and hypothyroidism, due to production of sulfocyanate."

Thienes and Haley also report "calcium cyanamide inhibits aldehyde oxidase and hence decreases tolerance to alcohol. The symptoms are headache, vertigo, vomiting, disturbance of respiration and occasionally fatal repiratory failure."

According to Patty, "hydrogen cyanide itself and its simple soluble salts . . ., are among the most rapidly acting of all known poisons. Ingestion of amounts as low as 50 - 100 mg of sodium or potassium cyanide may be followed by almost instantaneous collapse and cessation of respiration. At much lower dosages, the earliest symptoms may be simply those of weakness, headaches, confusion, and occasionally nausea and vomiting."

He reports the fatal dose of sodium cyanide by oral ingestion "probably on the order of 1 - 2 mg/kg in man as it is in a variety of experimental animals." The oral LD50 for calcium cyanide he reports is 6.02 plus or minus 3.3 mg/kg, and the acute toxicity of calcium cyanamide "is low; the oral lethal dose is said to be 40 - 50 g in an adult."

According to Stauden, "the cyanides are true protoplasmic poisons, combining in the tissues with enzymes associated with cellular oxidation and causing death through asphyxia, in the stomach is rapidly fatal, one milligram of cyanide per kilogram of body weight being deadly."

Stecher gives the LD50 orally in dogs as 1.6 mg/kg for potassium cyanide.

Hamilton and Hardy note that "HCN is a rapidly acting poison. Its behavior in the body is the result of paralysis of the respiratory enzyme cytochrome oxidase by direct action of the cyanide ion. This action is shared by all the soluble inorganic cyanide salts. The behavior of the CN ion prevents the uptake of oxygen by the tissues with resulting asphyxial death."

It is clear that classifications of 1 and 5 are most appropriate for these substances.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

National Fire Protection Association, "Fire Protection Guide on Hazardous Material," 5th edition, 1975 (NFPA)

Manufacturing Chemists' Association, Chemical Safety Data Sheet SD-30 (MCA)

E. I. duPont de Nemours and Co., Technical Bulletin SP 8-569 and "Cyanobrik - Cyanogram" (duP)

Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 6, p. 596 and p. 585 (K-O)

Sources of data items used:

I. A. 1. Synonyms: NFPA-49
2. Formula: NFPA-49, MCA
3. Molecular weight: duP

B. 1. Boiling point: MCA, duP
2. Specific gravity: duP, K-O
3. Vapor density: Not applicable
4. Melting point: duP

5. Vapor pressure: ADL
6. Solubility in water: duP
7. Evaporation rate: Not applicable
8. Appearance and odor: NFPA-49, MCA

II. A. 1. Not combustible
B. 1. Conditions contributing to instability: MCA, ADL
2. Incompatibilities: NFPA-491M, MCA, duP
3. Hazardous decomposition products: duP
4. Special precautions: duP

III. A. Steps if released or spilled: MCA, duP
C. Waste disposal method: MCA, duP

V. Miscellaneous precautions: NFPA-49, duP, K-O

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

Baskin, A. D. - editor, "Handling Guide for Potentially Hazardous Commodities," Railway Systems and Management Assoc., Chicago, 1972 (Baskin)

"Calcium Cyanide," American Cyanamid Co., Material Safety Data Sheet, April 12, 1973 (Cyanamid MSDS)

"Cyanogen," Matheson Gas Products Co., Bulletin (Matheson)

"Cyanogen Bromide," Eastman Kodak Co., Material Safety Data Sheet (Kodak)

Gleason, M. N. et. al., "Chemical Toxicology of Commercial Products," Williams and Wilkins Co., Baltimore, 1969 (Gleason)

Hamilton, A. and Hardy, H. L., "Industrial Toxicology," Publishing Sciences Group, Inc., 3rd edition, 1974 (H/H)

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"Hydrogen Cyanide," Commonwealth of Pennsylvania, Department of Environmental Resources, Occupational Health, Hygienic Information Guide No. 21, February, 1973 (Penna #21)

International Labour Office, "Encyclopedia of Occupational Health and Safety," Geneva, 1972 (ILO)

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Patty, F. A., "Industrial Hygiene and Toxicology," Vol. II, Interscience, 1962 (Patty)

"Potassium Cyanide," E. I. duPont de Nemours Co., Technical Information Bulletin SP8-569 (duPont KCN)

"Sodium Cyanide," E. I. duPont de Nemours and Co., "Cyanobrik, Cyanogran," April 1970 (duPont NaCN)

"Sodium Cyanide," Manufacturing Chemists' Association, Chemical Safety Data Sheet SD-30, 1967 (MCA)

Spencer, E. Y., "Guide to Chemicals Used in Crop Protection," 6th edition, (Publication 1093), Research Branch Agriculture Canada, 1973 (Spencer)

Thienes, C. H. and Haley, T. J., "Clinical Toxicology," 5th edition, Lea and Febiger, 1972 (Thienes and Haley)

References for Specific Use/Exposure

1. Matheson, Cyanamid MSDS, K-O, Gleason, ILO, Spencer, Baskin, H/H, Patty
2. duPont NaCN, Hunter, Baskin, K-O
3. H/H, ILO, Patty, K-O, Thienes and Haley, duPont NaCN, Matheson

4. duPont NaCN, Baskin, ILO, Hunter, Patty, K-O
5. duPont NaCN, duPont HCN, Matheson, ILO, Patty, MCA, K-O, Gleason
6. Thienes and Haley, Patty
7. Patty, ILO, K-O, Matheson, Baskin, duPont NaCN
8. Baskin, Hunter, ILO
9. ILO, Patty, Baskin
10. ILO, Patty, Hunter

References for Specific Control Methods

duPont HCN, Kodak, Baskin, MCA, Cyanamid MSDS, ILO, Penna #21, Matheson were the references used in all the Specific Control Methods.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Cyanide (as CN)

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

WARNING PROPERTIES:

Odor Threshold: There is no quantitative information available concerning the odor threshold of sodium or potassium cyanide. HCN, however, is evolved from these substances in the pressure of moisture. The Manufacturing Chemists Association states that, "Although HCN has a characteristic odor, its toxic action at hazardous concentrations is so rapid that it is of no value as a warning property."

Eye Irritation Level: Cyanide (as CN) is not known to be an eye irritant. HCN can produce eye irritation after chronic exposures, however (Grant). For the purposes of this standard, half-facepiece respirators are permitted unless eye irritation occurs. If eye irritation does occur, a full facepiece respirator must be worn.

Evaluation of Warning Properties: Although cyanide (as CN) has a negligible vapor pressure, in the presence of moisture HCN can be given off. Since HCN does not have adequate warning properties, gas sorbent respiratory protective equipment is not permitted.

IDLH: 50 mg/M3

Basis for IDLH Value: There is no useful acute inhalation toxicity information available upon which to base the IDLH concentration for cyanide (as CN). For the purposes of this standard, therefore, the chosen IDLH is based upon an analogy with hydrogen cyanide. According to the Documentation of TLV's, Patty states that hydrogen cyanide, at a concentration of 110 to 135 ppm, might be fatal to man "after 1/2 to 1 hr. or later, or dangerous to life." A concentration of 45 - 54 ppm (49.5-59.4 mg/M3) could be "tolerated for 1/2 to 1 hr. without immediate or late effects."

Other Toxicological Information: Gleason notes that "the alkali salts are usually toxic only when ingested."

Thienes and Haley report that the "average fatal dose of sodium or potassium cyanide is about 0.25 gm. However, one-fourth this amount has caused death."

In contrast to Gleason's comment about the toxicity of the alkali salts, Patty notes that sodium cyanide "can produce acute symptoms by inhalation and by skin absorption as well as by ingestion."

According to the Documentation of TLV's, "the lesser limit of 5 mg/M3 for alkali cyanides compared with that of HCN is based on the added irritation caused by the alkalinity, sufficient to result in epistaxis (nosebleed) and nasal ulceration. The air concentration of cyanide from the alkali cyanides producing this effect did not greatly

exceed 5 ppm."

NOTE: Additional inhalation toxicological information is needed to set a more accurate IDLH.

USE/EXPOSURE AND CONTROL DOCUMENT
CYANIDE

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of dust, gas or vapor and skin contact with gas or solid during use of cyanides (calcium cyanides, cyanogen, and cyanogen chloride or bromide) as fumigants and pesticides in greenhouses, ships, mills, warehouses. Cyanogen chloride (lachrimator) is used as a warning agent in fumigant gases.	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, gloves, goggles, protective clothing); good personal hygiene practice
2.	Inhalation of dust, gas, vapor or mist and skin contact with gas, liquid or solid during use of cyanides (sodium, potassium, and cuprous cyanides, potassium ferricyanide) in electroplating of copper, brass, iron, gold, silver, copper, zinc, cadmium	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, gloves, goggles, protective clothing); good personal hygiene practice
3.	Inhalation of dust, gas or vapor and skin contact with gas or solid during use of cyanides (calcium, potassium, and sodium cyanides, potassium ferrocyanide) for metal treatment: nitriding, tempering, and case hardening of steel; coloring of metals by chemical or electrolyic processes; cleaning and coating of metals; welding and cutting of heat resistant metals	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, gloves, goggles, protective clothing); good personal hygiene practice
4.	Inhalation of dust, gas or vapor and skin contact with gas or solid during use of cyanides (sodium and calcium cyanides) for ore extraction and	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, gloves,

	metal purification: extracting of gold and silver from ores; electrolytic refining of platinum; froth flotation of ores - separation of lead sulfide in lead-zinc ores, separation of copper sulfide from iron and lead sulfides		goggles, protective clothing); good personal hygiene practice
5.	Inhalation of dust, vapor or gas and skin contact with solid, liquid, or gas during manufacture and distribution of cyanides and during maintenance of equipment and storage containers	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, gloves, goggles, protective clothing); good personal hygiene practice
6.	Inhalation of dust or gas and skin contact with solid or gas during use of calcium cyanamid in fertilizer	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, gloves, goggles, protective clothing); good personal hygiene practice
7.	Inhalation of dust, vapor or gas and skin contact with gas, liquid, or solid during use of cyanides in chemical synthesis: manufacture of intermediates for synthesis of pharmaceuticals, dyes, vitamins, plastics, sequestering agents; preparation of nitriles, carbylamines, cyano fatty acids, inorganic cyanides	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, gloves, goggles, protective clothing); good personal hygiene practice
8.	Inhalation of dust, vapor or gas and skin contact with gas, liquid or solid during use of cyanides (potassium and sodium cyanides, potassium ferro-	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, gloves,

	and ferricyanides) in photography: as fixatives, in blueprinting and process engraving		goggles, protective clothing); good personal hygiene practice
9.	Inhalation of dust, gas or vapor and skin contact with solid, liquid or gas during use of cyanides (calcium and potassium cyanides, cyanogen bromide, potassium ferrocyanide) in cellulose technology, in paper manufacture, in dyeing, as cement stabilizers	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, gloves, goggles, protective clothing); good personal hygiene practice
10.	Inhalation of cyanide gas during evolution in blast furnace gases or during manufacture and handling of illuminating gas	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, gloves, goggles, protective clothing); good personal hygiene practice

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