

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** ACRYLONITRILE ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for ACRYLONITRILE

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 ACRYLONITRILE.

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 acrylonitrile not in excess of 20 parts per million (ppm) (45 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 acrylonitrile.

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

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

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

(ii) Any measurements of acrylonitrile taken;

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

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

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

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

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

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

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

(6) If an employee exposure measurement reveals that an employee is exposed to acrylonitrile 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 acrylonitrile 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 acrylonitrile below the action level, the employer may terminate measurement for the employee.

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(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	$\pm 25\%$
At or below permissible exposure and above the action level	$\pm 35\%$
At or below the action level	$\pm 50\%$

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

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

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

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

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

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

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

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

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(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of acrylonitrile 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.

TABLE 2 RESPIRATORY PROTECTION FOR ACRYLONITRILE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Vapor Concentration	
500 ppm or less	Any supplied-air respirator with a full facepiece, helmet or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 500 ppm 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. (Supplied-air suits may be necessary.)
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 organic vapors. Any escape self-contained breathing apparatus.

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(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 acrylonitrile.

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

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

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

(5) For the purpose of compliance with § 1910.106, liquid acrylonitrile is classified as a Class IB flammable liquid.

(6) Where a fan is located in ductwork and where acrylonitrile is present in the ductwork in concentrations greater than 7500 ppm (approximately 25 percent of the lower flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

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

(8) Acrylonitrile shall be stored so as not to come in contact with strong oxidizers (especially bromine), strong bases, copper, copper alloys, ammonia, and amines. The monomer shall be checked at least weekly to determine inhibitor content.

(f) Personal protective equipment. (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid acrylonitrile. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that clothing wet with liquid acrylonitrile is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of acrylonitrile from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the acrylonitrile, the employer shall inform the person performing the operation of the hazardous properties of acrylonitrile.

(3) Where exposure of an employee's body to liquid acrylonitrile may occur, employers shall provide facilities for quick drenching of the body within the immediate work area for emergency use.

(4) Employers shall ensure that any clothing which becomes wet with or non-impervious clothing which becomes contaminated with acrylonitrile be removed immediately and not reworn until the acrylonitrile is removed from the clothing.

(5) Employers shall provide and ensure that employees use splash-proof safety goggles (cup-cover type dust and splash safety goggles) which comply

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with § 1910.133 (a)(2)-(a)(6) where liquid acrylonitrile may contact the eyes.

(g) Spills and disposal. (1) In the event that liquid acrylonitrile is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation and then clean up the spill.

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

(h) Sanitation. Employers shall ensure that employees whose skin becomes wet with liquid acrylonitrile immediately wash or shower to remove any acrylonitrile from the skin.

(i) Training and information. (1) Each employer who has a workplace in which acrylonitrile 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 acrylonitrile above the action level or employees who may have skin or eye contact with liquid acrylonitrile, or employees who work where acrylonitrile presents a fire or explosion hazard, shall annually:

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

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

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

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

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

(2) The employer shall make available to each employee who is to be exposed to liquid acrylonitrile or airborne concentrations of acrylonitrile at or above the action level, a medical examination which shall include a medical history and physical examination with emphasis on the cardiovascular system, liver, kidney, nervous system, and skin.

(3) The employer shall obtain from the physician, as a record of the examination, a written opinion which conforms with paragraph (j)(7) of this section.

(4) The employer shall make available to each employee, exposed to acrylonitrile in excess of the action level at 12 months from the date of the employee's first exposure, and at every 12 months of exposure in excess of the action level thereafter, a medical examination which must include a medical history and physical examination with emphasis on the cardiovascular system, liver, kidney, nervous system and skin.

(5) The employer shall obtain from the physician, as a record of the periodic examination, a written opinion which conforms with paragraph (j)(7) of this section.

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

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(i) A copy of this regulation with its Appendixes A, B, and C for acrylonitrile;

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

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

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

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

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

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

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

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

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

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

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

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

(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 risks involved by refusing to be examined.

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

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

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

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

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

(ii) This record shall include:

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- (A) The date of measurement;
 - (B) Operations involving exposure to acrylonitrile which are being monitored;
 - (C) Sampling and analytical methods used and evidence of their accuracy, including the method, results and date of calibration of sampling equipment;
 - (D) Number, duration, and results of samples taken; and
 - (E) Name, social security number and exposure of the employee monitored.
- (iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

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

(ii) This record shall include:

- (A) Date of measurement;
- (B) Type of measurement taken;
- (C) Result of measurement.

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

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

(ii) This record shall include:

- (A) Date of training;
- (B) Name and social security number of employee trained;
- (C) Content or scope of training provided.

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

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

(ii) This record shall include:

- (A) Results of tests required by paragraph (j)(2) and (j)(5) of this section;
- (B) Any employee medical complaints relative to exposure to acrylonitrile;
- (C) A copy of information provided to the physician pursuant to paragraph (j)(6)(ii), (iii), (iv), (v), and (vi) of this section.
- (D) Physician's written opinion; and
- (E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

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

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

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(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 affected employees or their representatives an opportunity to observe any measurement of employee exposure to acrylonitrile which is conducted pursuant to this section.

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

(iii) Record the results obtained.

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

APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR ACRYLONITRILE

I. SUBSTANCE IDENTIFICATION

A. Substance: Acrylonitrile

B. Permissible Exposure: 20 parts of acrylonitrile per million parts of air (ppm) (45 milligrams of acrylonitrile per cubic meter of air, (mg/M3)) averaged over an eight-hour work shift.

C. Appearance and Odor: Colorless to pale yellow liquid with a pungent odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Acrylonitrile can affect your body if you inhale it, if it comes in contact with your eyes or skin, or if you swallow it. It may enter your body through your skin.

B. Effects of Overexposure:

1. Short-Term Exposure: Acrylonitrile causes eye irritation, nausea, vomiting, headache, sneezing,

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weakness, and light-headedness. At high concentrations the effects of exposure may go on to loss of consciousness and death. When acrylonitrile is held in contact with the skin after being absorbed into shoe leather or clothing, it may produce blisters following several hours of no apparent effect. Unless the shoes or clothing are removed immediately and the area washed, blistering will occur. Usually there is no pain or inflammation associated with blister formation.

2. Long-Term Exposure: Repeated or prolonged exposure may produce irritation of the skin.
3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are caused by exposure to acrylonitrile.

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If acrylonitrile 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 acrylonitrile gets on your skin, immediately wash the contaminated skin with water. If acrylonitrile soaks through your clothing (especially your shoes), remove the clothing immediately and wash the skin with water. If symptoms occur after washing, get medical attention immediately.
- C. Breathing: If you or any other person breathes in large amounts of acrylonitrile 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 acrylonitrile 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 equipment before the need arises.
- F. Special First Aid Procedures: First aid kits containing an adequate supply of amyl nitrite pearls (ampules) should be maintained at each site where acrylonitrile is used. When a person is suspected of receiving an overexposure to acrylonitrile, immediately remove him from the contaminated area using established rescue procedures. Contaminated clothing must be removed and the acrylonitrile washed from the skin immediately. Artificial resuscitation should be started at once if breathing has stopped. A pearl of amyl

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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 acrylonitrile. 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 acrylonitrile 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. Supplied-air suits: in some work situations the wearing of supplied-air suits may be necessary. Your employer should instruct you in their proper use and operation.
- C. Protective Clothing: You must wear impervious clothing, gloves, face shield or other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid acrylonitrile. Replace or repair impervious clothing that has developed leaks.
- D. Eye Protection: You must wear splash-proof safety goggles where liquid acrylonitrile may contact your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. Acrylonitrile is a flammable liquid and its vapors can easily form explosive mixtures in air.
- B. Acrylonitrile must be stored in tightly closed containers in a cool, well ventilated area away from heat, sparks, flames, strong oxidizers (especially bromine), strong bases, copper, copper alloys, ammonia, and amines.
- C. Sources of ignition such as smoking and open flames are prohibited wherever acrylonitrile is handled, used or stored in a manner that could create a potential fire or explosion hazard.

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- D. You should use non-sparking tools when opening or closing metal containers of acrylonitrile, and containers must be bonded and grounded when pouring or transferring liquid acrylonitrile.
- E. You must immediately remove any non-impervious clothing that becomes contaminated with acrylonitrile and this clothing must not be reworn until the acrylonitrile is removed from the clothing.
- F. Clothing wet with liquid acrylonitrile can be easily ignited. You must immediately remove this clothing and it must not be reworn until the acrylonitrile is removed from the clothing.
- G. If your skin becomes wet with liquid acrylonitrile, you must immediately wash or shower to remove the acrylonitrile from your skin.
- H. Fire extinguishers 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 acrylonitrile is used in your work area and for any additional plant 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 acrylonitrile. In addition, your employer must instruct you in the safe use of acrylonitrile, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to acrylonitrile. You or your representative have the right to observe employee exposure measurements and to record the results obtained. If your employer determines that you are being overexposed, he is required to inform you of the exposure and of the actions which are being taken to reduce your exposure.
- C. Your employer is required to keep records of exposure determinations, exposure measurements, and medical surveillance. Your employer is required to make records of exposure determinations and your exposure measurements available to you or your representative upon your request. Your employer is required to release your medical records to your physician upon your written request.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
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- I. PHYSICAL AND CHEMICAL DATA
 - A. Substance Identification

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1. Synonyms: Propenenitrile; AN; vinyl cyanide
2. Formula: $\text{CH}_2 = \text{CHCN}$
3. Molecular weight: 53.1

B. Physical Data

1. Boiling point (760 mm Hg): 77.3 C (171 F)
2. Specific gravity (water = 1): 0.81
3. Vapor density (air = 1 at boiling point of acrylonitrile): 1.83
4. Melting point: -83 C (-117 F)
5. Vapor pressure at 20 C (68 F): 83 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): 7.08
7. Evaporation rate (butyl acetate = 1): 4.54
8. Appearance and odor: Colorless to pale yellow liquid with a pungent odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: -1 C (30 F) (closed cup)
2. Autoignition temperature: 481 C (898 F)
3. Flammable limits in air, % by volume: Lower: 3; Upper: 17
4. Extinguishing media: Alcohol foam, carbon dioxide, dry chemical
5. Special fire-fighting procedures: Do not use a solid stream of water since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Acrylonitrile is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where acrylonitrile is handled, used or stored in a manner that could create a potential fire or explosion hazard. Acrylonitrile vapors are heavier than air and may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which acrylonitrile is handled.
7. For purposes of conforming with the requirements of 29 CFR 1910.106, acrylonitrile is classified as a Class IB flammable liquid. For example, 7500 ppm, approximately one-fourth of the lower flammable limit, is one situation in which acrylonitrile is considered to be a potential fire and explosion hazard.
8. For purposes of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for acrylonitrile shall be Class I Group D.

B. Reactivity

1. Conditions contributing to instability: Acrylonitrile will polymerize when hot, and the heat liberated may cause containers to explode.
2. Incompatibilities: Contact with strong oxidizers (especially bromine) and strong bases may cause fires

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and explosions. Contact with copper, copper alloys, ammonia, and amines may start serious decomposition.

3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen cyanide, oxides of nitrogen and carbon monoxide) may be released in a fire involving acrylonitrile.
4. Special precautions: Liquid acrylonitrile will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

- A. If acrylonitrile is spilled or leaked, the following steps should be taken:
 1. Remove all ignition sources.
 2. Ventilate area of spill or leak.
 3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for vapors to completely clear hood ductwork, then burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. Acrylonitrile may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.
- B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.
- C. Waste disposal methods: Acrylonitrile may be disposed of by 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: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the average 8-hour exposure may be determined from a single eight-hour sample or two (2) 4-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The method of measurement must determine the concentration of acrylonitrile 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 acrylonitrile 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 K" (Order number XXXXXXXXXX).
- D. QUALIFIED PERSONS: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

- A. Store acrylonitrile in tightly closed containers in a cool, well ventilated area.
- B. High exposures to acrylonitrile can occur when transferring the liquid from one container to another.
- C. Non-sparking tools must be used to open and close metal acrylonitrile containers. These containers must be effectively grounded and bonded prior to pouring.
- D. Never store uninhibited acrylonitrile. The inhibitor content shall be determined weekly.
- E. Acrylonitrile vapors are not inhibited. They may form polymers and clog vents of storage tanks.
- F. Use of supplied-air suits or other impervious coverings may be necessary to prevent skin contact with acrylonitrile where the concentration of acrylonitrile is unknown or is greater than 500 ppm. Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitations and potential life endangering characteristics of supplied-air suits.
- G. Employers should advise employees of all areas and operations where exposure to acrylonitrile could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to acrylonitrile is likely to occur are: during its production and during the synthesis of ABS rubber, acrylic fibers, cyanoethylated cotton, plastic resins and nitrile elastomers and surface coatings; and during its use in chemical synthesis and as a fumigant.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. TOXICOLOGY

Acrylonitrile vapor is an asphyxiant due to inhibitory action on metabolic enzyme systems. Animals exposed to 75 or 100 ppm for 7 hours showed signs of anoxia; some animals died at the higher level; cyanomethemoglobin was found in the blood. Two human fatalities from accidental poisoning have been reported; one was caused by inhalation of

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an unknown concentration of the vapor and the other was thought to be caused by skin absorption or inhalation. Most cases of intoxication from industrial exposure have been mild, with rapid onset of eye irritation, headache, sneezing, and nausea; weakness, light-headedness, and vomiting may also occur. Exposure to high concentrations may produce profound weakness, asphyxia, and death. The vapor is a severe eye irritant. Prolonged skin contact with the liquid may result in absorption with systemic effects and in the formation of large vesicles after a latent period of several hours. Although there is usually little or no pain or inflammation, the affected skin resembles a second degree thermal burn. Solutions spilled on exposed skin, or on areas covered only by a light layer of clothing, evaporate rapidly leaving no irritation or, at the most, mild transient redness. Repeated spills on exposed skin may result in dermatitis due to solvent effects.

III. SIGNS AND SYMPTOMS

Asphyxia and death can occur from high exposures. Eye irritation; headache; sneezing; nausea and vomiting; weakness and light-headedness; vesicles from prolonged skin contact; repeated skin contact may produce scaling dermatitis.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Immediately flush eyes with water and wash skin with soap or mild detergent and water. If swallowed and the person is conscious, induce vomiting. Give artificial resuscitation if indicated. More severe cases, such as those associated with loss of consciousness, may be treated by the intravenous administration of sodium nitrite followed by sodium thiosulfate, although this is not as effective for acrylonitrile poisoning as for inorganic cyanide poisoning.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of acrylonitrile are due to its capacity for producing tissue anoxia and asphyxia. The effects are similar to those caused by hydrogen cyanide. The liquid readily penetrates leather and will produce second degree burns of the feet on prolonged contact. Skin absorption is known to occur. It is important that the physician become familiar with plant operating conditions in which exposure to acrylonitrile 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

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The following medical procedures must be made available to each employee who is exposed to acrylonitrile:

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 unusually susceptible to effects of anoxia or those with anemia would be expected to be at increased risk. Examination of cardiovascular system, liver, kidney, and nervous system 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: "Acrylonitrile," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 6.
2. Hygienic Guide Series: "Acrylonitrile," American Industrial Hygiene Association Journal, 18:78-79, 1957.
3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1992, 2009-2012.
4. Manufacturing Chemists Association, Inc.: Chemical Safety Data Sheet SD-31, Acrylonitrile, Washington, D.C., 1974, pp. 16-19.
5. Brieger, H., et al: "Acrylonitrile: Spectrophotometric Determination, Acute Toxicity, and Mechanism of Action," AMA Archives of Industrial Hygiene and Occupational Medicine, 6:128-140, 1952.
6. Wolfsie, J.H.: "Treatment of Cyanide Poisoning in Industry," AMA Archives of Industrial Hygiene and Occupational Medicine, 4:417-425, 1951.

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REFERENCES AND SOURCES
ACRYLONITRILE
1910.93

- (e) Fire and Safety
- (1) Electrical - Classification based on "Fire Hazard Classification of Chemical Vapors Relative to Explosion-proof Electrical Equipment," H. Carhart et al., National Academy of Sciences, 1973, report to U. S. Coast Guard, report no. CG-D-92-74, p. 8.
- (f) Personal Protective Equipment, and, (h) Sanitation
- Eye: Grant, "Toxicology of the Eye;" Union Carbide Corporation, "Toxicology Studies - Acrylonitrile;" Smyth et al., "Further Experience With the Range Finding Test in the Industrial Toxicology Laboratory," Journal Indus. Hyg. and Tox., 30:1, 1942, p. 63; Carpenter and Smyth, "Chemical Burns of the Rabbit Cornea," Am. Jour. of Opth., 26, 1946, p. 1363; Cyanamid, "Handling - Storage - Analyses of Acrylonitrile;" McOmie, "Comparative Toxicity of Methacrylonitrile and Acrylonitrile," Jour. of Indus. Hyg. and Tox., 31:2, 1949, p. 113
- Skin: MCA, Chemical Safety Data Sheet, "Acrylonitrile;" AIHA Hygienic Guide Series, "Acrylonitrile;" Kirk - Othmer, "Encyclopedia of Chemical Technology;" Gleason, "Clinical Toxicology of Commercial Products;" Patty, "Industrial Hygiene and Toxicology;" Union Carbide Corporation, "Toxicology Studies - Acrylonitrile;" Smyth et al., "Further Experience With the Range Finding Test in the Industrial Toxicology Laboratory," Jour. Indus. Hyg. and Tox., 30:1, 1942, p. 63; Cyanamid, "Handling - Storage - Analysis of Acrylonitrile;" MCA, "Accident Case Histories;" Wilson and McCormick, "Acrylonitrile - Its Physiology and Toxicology," Indus. Med., 18:6, 1949, p. 243; McOmie, "Comparative Toxicity of Methacrylonitrile," Jour. of Indus. Hyg. and Tox., 31:2, 1949, p. 113
- Ingestion: MCA, Chemical Safety Data Sheet, "Acrylonitrile;" Patty, "Industrial Hygiene and Toxicology;" Spector, "Handbook of Toxicology;" Union Carbide Corporation, "Toxicology Studies - Acrylonitrile;" Gleason, "Clinical Toxicology of Commercial Products"

COMMENTS

Eye - Classification: 2

Output statement numbers: 10

Exceptions: None

According to Grant, "when applied as a single drop to a rabbit cornea, it (acrylonitrile) has caused only a transient disturbance without corneal opacification." Union Carbide lists acrylonitrile as a hazard to the eye, stating that "two drops of the undiluted chemical caused surface eye burns in rabbits (while) one small drop, such as might occur with a fine spray, caused minor injury." Smyth et al. ranked the effect of eye exposure to the liquid at 4 on a scale of 1 to 10. This indicates that 0.02 ml undiluted causes less than severe injury in 24 hours and that 0.1 ml causes severe injury. Cyanamid states that "severe irritation results when the substance enters the

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eye." Work by McOmie showed that exposure to a drop of acrylonitrile caused immediate irritation; the mild conjunctivitis which developed cleared in 24 hours. It is concluded that a classification of 2 is adequate.

Skin - Classification: 2

Output statement numbers: 2, 7b, 8b, 14g and 21 combined, Exceptions: 14i modified, 14g used

According to MCA "studies in animals have shown that acrylonitrile, when maintained in contact with the skin for prolonged periods (as under an impervious covering), is readily absorbed to produce serious illness and death; systemic intoxication from contact with the uncovered skin has rarely, if ever, been observed in man, probably because acrylonitrile evaporates before toxic quantities can be absorbed." MCA continues "spills on exposed area of the skin or on areas covered by a light layer of clothing evaporate readily leaving no irritation or, at the most, mild transient redness." However, when held close to the skin, large blisters form which resemble "extensive second degree thermal burns" except that "usually there is no pain or inflammation." MCA also notes "repeated spills on exposed skin areas may result in dermatitis of the type seen after similar exposures to organic solvents." The Hygienic Guide states that it is "readily absorbed through the skin." Kirk-Othmer rates the substance "a low-grade primary skin irritant." Gleason reports that erythema and later painful skin blisters may result from skin contact. Patty refers to acrylonitrile as a "severe skin irritant." The cutaneous rabbit LD50 is 250 mg/kg, according to Spector. Union Carbide reports a rabbit single skin penetration LD50 of 0.53 ml/kg and notes "rapid skin penetration of a very toxic compound." The same group rated the hazard as a skin irritant as "slight;" continuing "the tender skin of the rabbit belly showed no reaction to the undiluted chemical," when the exposure was to the uncovered intact skin. Smyth et al. report a rabbit skin penetration LD50 of .25 ml/kg. Cyanamid data note that "contact of moderate amounts of acrylonitrile with the skin gives rise to a stinging sensation and may produce severe blisters." The MCA reports a case of human exposure which resulted from stepping into pools of acrylonitrile: the symptoms consisted of irritation the afternoon following exposure, and late in the afternoon, the formation of blisters which burst. Wilson and McCormick showed that hypodermic injection of 85 mg/kg to guinea pigs caused death within 12 hours. Gleason states that acrylonitrile is "similar to but less toxic than its molecular equivalent in hydrogen cyanide." McOmie found that application of 3.0 ml/kg over a 200 sq cm area of shaved rabbit belly did not produce death, but resulted in systemic effects - depression with increased respirator rate; recovery was complete, however. The flashpoint of acrylonitrile is

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-1 C. Its vapor pressure at 20 C is 83 mm Hg and it is 7 percent soluble in water.

A classification of 2 is concluded to be appropriate if statement 14g is used to prevent contained contact, statement 8b is used to prevent absorption of harmful amounts where "extensive exposure" may occur, and statement 14i is modified so that skin that becomes "wet" with acrylonitrile is immediately washed as the volatility of the substance indicates that a few drops on exposed skin will evaporate before causing harmful effects. Statement 20a is not used because of the volatility of the substance.

Ingestion - Classification: 0

Output statement numbers: None

Exceptions: None

MCA states "acrylonitrile is moderately toxic by this route of exposure, although considerably less so than the inorganic cyanides." Patty states that acrylonitrile is readily absorbed by mouth. The oral rat LD50 is about 78 mg/kg, according to Patty, continuing, "rats ingesting 0.1 percent in water for a period of 13 weeks showed retarded growth and emaciation (and) some effects were also noted with as low as 0.05 percent in water in 2-year feeding studies." Spector reports an oral rat LD50 of 93 mg/kg. Union Carbide concludes that acrylonitrile is a "serious hazard" through ingestion: "Swallowing small quantities of this chemical may cause death." Gleason states that acrylonitrile is "similar to but less toxic than its molecular equivalent in hydrogen cyanide." The volatility of the substance leads to the conclusion that ingestion would not pose a problem in the workplace.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

Manufacturing Chemists' Association, Chemical Safety Data Sheet SD-31 (MCA)

National Fire Protection Association, "Fire Protection Guide on Hazardous Materials," 5th edition, 1973 (NFPA)

Union Carbide Corp., Material Safety Data Sheet (UCC)

Monsanto Co., Material Safety Data Sheet (Mons)

American Cyanamid Co., "Handling, Storage, Analyses of Acrylonitrile" and Material Safety Data Sheet (Cyan)

Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 1, p. 338 (K-O)

Sources of data items used:

- I. A. 1. Synonyms: MCA; Mons; UCC
- 2. Formula: MCA; UCC
- 3. Molecular weight: K-O
- B. 1. Boiling point: MCA; UCC
- 2. Specific gravity: MCA; UCC
- 3. Vapor density: MCA; UCC
- 4. Melting point: MCA; UCC
- 5. Vapor pressure: MCA; UCC

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- 6. Solubility in water: UCC
- 7. Evaporation rate: UCC; Cyan
- 8. Appearance and odor: MCA; UCC
- II. A. 1. Flash point: MCA; Mons
- 2. Autoignition temperature: MCA; NFPA-325M
- 3. Flammable limits: NFPA-325M; MCA; UCC
- 4. Extinguishing media: MCA
- 5. Special fire fighting procedures: NFPA-49; MCA; Mons
- 6. Unusual fire and explosion hazards: NFPA-49; MCA
- B. 1. Conditions contributing to instability: UCC; Mons
- 2. Incompatibilities: NFPA-49; MCA; UCC; NFPA 491M
- 3. Hazardous decomposition products: MCA; UCC; Cyan
- 4. Special precautions: ADL
- III. A. Steps if released or spilled: Cyan; ADL
- C. Waste disposal method: MCA; Cyan; UCC; Mons
- V. Miscellaneous precautions: NFPA-49; MCA; Cyan; Mons

USE/EXPOSURE AND CONTROL DOCUMENT

Reference used in the preparation of this document include:

- "Chemical Safety Data Sheet SD-31," Acrylonitrile, Manufacturing Chemists' Association, 1974 (CSDS)
- Considine, D. M., "Chemical and Process Technology Encyclopedia," McGraw Hill, 1974 (Considine)
- Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience Publishers, 1954 (Chem Tech)
- Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," 2nd edition, Interscience Publishers, 1972 (K-0)
- Mark, H. F., Gaylord, N. G. and Bikales, N. M., "Encyclopedia of Polymer Science and Technology," Interscience Publishers, 1964 (Poly Sci)
- Stanford Research Institute, "Chemical Economics Handbook" (SRI)
- Stephenson, R. M., "Introduction to the Chemical Process Industries," Reinhold Publishing Corp., 1966 (Stephenson)
- "The Chemistry of Acrylonitrile," American Cyanamid Company, Synthetic Organic Chemicals Dept., 1951 (Cyanamid)

References for Specific Use/Exposure

- 1. Considine, Stephenson, SRI
- 2. Poly Sci, SRI
- 3. Chem Tech, K-0, SRI
- 4. Cyanamid, SRI
- 5. SRI
- 6. K-0, Poly Sci
- 7. Poly Sci, Stephenson, SRI
- 8. CSDS
- 9. Cyanamid, SRI

References for Specific Control Methods

- 1. CSDS
- 2. CSDS
- 3. CSDS
- 4. CSDS
- 5. CSDS
- 6. CSDS
- 7. CSDS
- 8. CSDS

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9. CSDS

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Acrylonitrile

D. O. L. STANDARD: 20 ppm

WARNING PROPERTIES:

Odor Threshold: Staub reports that the odor threshold of acrylonitrile is 19 ppm. Patty reports, however, that "the sense of smell fatigues rapidly and is unreliable as an index of exposure," to acrylonitrile.

Eye Irritation Level: Grant states that acrylonitrile "vapor at concentrations which are dangerous to inhale causes irritation of the . . . eyes." Specific concentrations which produce eye irritation are not given.

Other Information: Grant reports that exposure to acrylonitrile can cause irritation of the nose, but no quantitative information is given.

Evaluation of Warning Properties: Since olfactory fatigue occurs rapidly upon exposure to acrylonitrile vapor, and since there is no quantitative information available concerning the irritant effects of acrylonitrile, this substance is treated as a material with poor warning properties. Gas sorbent respiratory equipment is not permitted.

IDLH: 500 ppm

Basis for IDLH Value: This IDLH is based upon Spector's report of a rat LC50 of 500 ppm for a 4-hour exposure.

Other Toxicological Information: According to Spector, early symptoms of acrylonitrile poisoning in man are "salivation, eye and nose irritation, skin flush, (and) rapid respiration. Other symptoms are weakness, light-headedness, headache, nausea, sneezing, abdominal pain, vomiting, unconsciousness, asphyxia, and finally death. Lethal doses in animals yield a temporary paralysis and then convulsions as prelude to death."

Spector reports a rat LC50 of 500 ppm for a 4-hour exposure; a rat MLC of 635 ppm for a 4-hour exposure with death occurring in 8 hours; and a dog MLC of 110 ppm for a 4-hour exposure with death occurring in 4 hours. Monkeys exposed to 90 ppm for 4 hours experienced only transient effects.

The Chemical Company Guides of Union Carbide Corporation report that a 4-hour exposure of rats to 500 ppm acrylonitrile killed no rats out of 6, but an 8-hour exposure to the same concentration killed 1 out of 6 rats. "Breathing 1000 ppm gave the following results: 1 hour's exposure killed none of six; 2 hours' exposure killed one of six; 4 hour's exposure killed all of six."

The Chemical Company Guides also state that the single skin penetration LD50 for rabbits is 0.53 ml/kg. "This result suggests rapid skin penetration of a very toxic compound. Skin contact must be avoided." Spector reports a rabbit skin penetration LD50 of 250 mg/kg.

LFL: 30,000 ppm

VAPOR PRESSURE: 83 mm Hg at 20 deg. C.

SATURATED CONCENTRATION AT 20 DEG. C.: Approximately 109,200 ppm

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ACRYLONITRILE

Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1. Inhalation of vapor and skin contact with liquid during use in the production of acrylic (at least 85% acrylonitrile) and modacrylic (35 - 85% acrylonitrile) fibers. 100% polyacrylonitriles are used mostly for industrial products because of poor dye properties (sandbags, tarpaulins, tents). Acrylic and modacrylic fibers are direct competitors for wool products (Orlon, Creslan, Dynel, Acrilan, Zefran - carpets and rugs, sweater, knitwear, deep pile fabrics including man-made furs, synthetic hair wigs)	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation
2. Inhalation of vapor and skin contact with liquid during use in the production of plastic resins. Acrylonitrile - butadiene - styrene (ABS) and styrene - acrylonitrile (SAN) resins are the most commonly used of acrylonitrile resins (ABS - pipe and gas fittings, housing for business machines, luggage typewriter cases; SAN - drinking tumblers, houseware items, automobile instrument panels, instrument lenses)	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation
3. Inhalation of vapor and skin contact with liquid during use in the production of nitrile elastomers. These elastomers which serve mainly as rubber substitutes are especially useful because of their	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation

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resistance to oil and hydrocarbon solvents - as the amount of acrylonitrile in the elastomer increases, oil resistance increases but resilience and low temperature flexibility decrease (Hycar OR, Paracril, Perbunan, Chemigum, Butaprene - gasoline hoses, linings for gas tanks, printing rolls, adhesives, conveyors, nonmarking shoe heels)

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|----|--|-------|---|
| 4. | Inhalation of vapor and skin contact with liquid during use as a chemical intermediate. Synthesis of dyes, antioxidants, pharmaceuticals, surface active agents, polar solvents, plasticizers, insecticides, etc. (Reaction may be of the double bond, of the nitrile group or of both). Synthesis of adiponitrile, which is used to manufacture nylon 66, is the largest single use for acrylonitrile as a chemical intermediate. | A,B,D | Process enclosure; local exhaust ventilation; general dilution ventilation |
| 5. | Inhalation of vapor and skin contact with liquid during the manufacture and processing of acrylonitrile (ammoxidation of propylene accounts for all of the the acrylonitrile produced in the U. S.) | A,B,D | Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, goggles, boots, protective clothing as the situation dictates) |
| 6. | Inhalation of vapor and skin contact with liquid during use in the cyanoethylation of natural materials (mostly cotton). The cyanoethylation modifies the properties of the natural products - increases strength and resistance to rot and mildew | A,B,D | Process enclosure; local exhaust ventilation; general dilution ventilation |

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|----|--|-------|--|
| 7. | Inhalation of vapor and skin contact with liquid during use in the manufacture of surface coatings (paper coatings - to impart tensile strength and oil resistance to specialty papers, leather finishing - pigment binders, latex paints, textile finishes) | A,B,D | Process enclosure; local exhaust ventilation; general dilution ventilation |
| 8. | Inhalation of vapor and skin contact with liquid during cleaning and maintenance of storage vessels and during clean up of accidental spills. | A,B,D | Local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, goggles, protective clothing, boots, respiratory protective devices) |
| 9. | Inhalation of vapor and skin contact with liquid during use as a fumigant (stored grain and tobacco) | A,B,D | Process enclosure; personal protective equipment (gloves, goggles, boots, protective clothing, respiratory protective devices) |

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

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

1,394 CARDS READ

0 SYSOUT PRINT RECORDS

0 SYSOUT PUNCH RECORDS

0.00 MINUTES EXECUTION TIME

[illegible]