

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** NICOTINE ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for NICOTINE

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 NICOTINE.

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 nicotine not in excess of 0.5 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 nicotine averaged over an eight-hour work shift.

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

(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 nicotine;

(ii) Any measurements of nicotine taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to nicotine; 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 nicotine 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 nicotine 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 nicotine 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 nicotine 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 nicotine 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 below the permissible exposure.

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

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

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(c) Methods of measurement. (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure 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 nicotine above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of nicotine 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 nicotine.

(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 nicotine to at or below the permissible exposure; or

(iv) For operations which require entry into tanks or closed vessels; or

(v) In emergencies.

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(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 nicotine 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 NICOTINE

CONDITION	PERMISSIBLE RESPIRATOR PROTECTION*
Particulate or Vapor Concentration	
5 mg/M3 or less	Any supplied-air respirator. Any self-contained breathing apparatus.
25 mg/M3 or less	Any supplied-air respirator with a full facepiece, helmet or hood. Any self-contained breathing apparatus with a full facepiece
35 mg/M3 or less	A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 35 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 organic vapors and particulates (including pesticide respirators which meet the requirements of this class.) Any escape self-contained breathing apparatus.

* Use of supplied-air suits may be necessary to prevent skin contact and respiratory exposure from airborne concentrations of nicotine. Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitation and potential life endangering characteristics of supplied-air suits. Where supplied-air

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suits are used above a concentration which may be immediately dangerous to life and health (35 mg/M3), an auxiliary positive-pressure self-contained breathing apparatus must also be worn.

(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 nicotine.

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

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

(4) Nicotine shall be stored so as not to come in contact with strong oxidizers and strong acids.

(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 liquid nicotine. Face shields shall comply with § 1910.133 (a)(2), (a)(4), (a)(5), and (a)(6).

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

(3) Where there is any possibility of exposure of an employee's body to liquid nicotine, employers shall provide facilities for quick drenching of the body within the immediate work area for emergency use.

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

(5) Employers shall provide and ensure that employees use splash-proof safety goggles which comply with § 1910.133 (a)(2)-(a)(6) where there is any possibility of liquid nicotine contacting the eyes.

(6) Where there is any possibility that an employee's eyes may be exposed to liquid nicotine, employers shall provide an eye-wash facility within the immediate work area for emergency use.

(g) Spills and disposal. In the event that liquid nicotine 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 liquid nicotine immediately wash or shower with soap or mild detergent and water to remove any nicotine from the skin.

(2) Employers shall ensure that employees do not eat or smoke in areas where liquid nicotine is handled, processed or stored.

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

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

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

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

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

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

(3) Periodic medical examination. The employer shall make available to each employee exposed to airborne concentrations of nicotine above the action level, without regard to the use of respirators, or employees who may have any possibility of skin or eye contact with liquid nicotine, 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 and nervous system.

(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 nicotine which are listed in Appendix A which the employee suspects are caused by exposure to nicotine.

(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 nicotine;

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

(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

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(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)(5) of this section, following such examination the employer shall obtain from the examining physician a written opinion which conforms with paragraph (j)(8) of this section.

(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 nicotine;

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

(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 nicotine.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to nicotine 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.

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(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 nicotine;
- (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 nicotine.

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

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

(2) When observation of measurement of employee exposure to nicotine 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.

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(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 nicotine that are being performed at the place of exposure; and
- (iii) Record the results obtained.

NOTE: The information contained in the following appendix for nicotine 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 nicotine, it is advisory in nature.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR NICOTINE

I. SUBSTANCE IDENTIFICATION

- A. Substance: Nicotine
- B. Permissible Exposure: 0.5 milligram of nicotine per cubic meter of air (mg/M3) averaged over an eight-hour work shift.
- C. Appearance and Odor: Pale yellow to dark brown liquid with a slight fishy odor when warm

II. HEALTH HAZARD DATA

- A. Ways in which the chemical affects your body: Nicotine 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 rapidly enter your body through your skin.
- B. Effects of Overexposure:
 - 1. Short-term Exposure: The action of nicotine is rapid either after breathing it, swallowing it, or absorbing it through the skin. Exposure to it may cause a burning sensation of the mouth and throat, abdominal pain, nausea, vomiting and diarrhea. It may also cause headache, sweating, dizziness, hearing and visual disturbances, confusion, weakness and incoordination. The heart may beat irregularly or stop. Trembling and convulsions, faintness, shortness of breath and collapse may occur which may be followed by death from respiratory paralysis. Exposure of the eyes and skin may cause irritation. Nicotine has caused abnormalities in the offspring of laboratory animals.
 - 2. Long-term Exposure: Not known.

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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 nicotine.

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If liquid nicotine or solutions of nicotine get 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 liquid nicotine or solutions of nicotine get on your skin, immediately flush the contaminated skin with water. If liquid nicotine or solutions of nicotine soak through your clothing, remove the clothing immediately and flush the skin with water. Get medical attention immediately.
- C. Breathing: If you or any other person breathes in large amounts of nicotine 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 liquid nicotine or solutions of nicotine have been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.
- 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.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

- A. Respirators: Respirators are not the best way to control exposure to nicotine. 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 nicotine 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.

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- B. Protective Suits: In some work situations the wearing of supplied-air suits or other impervious coverings such as acid suits may be necessary. Your employer should instruct you in their proper use and operation.
- C. Protective Clothing: You must wear appropriate protective clothing and equipment to prevent any possibility of skin contact with liquid nicotine. Replace or repair impervious clothing which has developed leaks.
- D. Eye Protection: You must wear splash-proof safety goggles where there is any possibility of liquid nicotine contacting your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. Nicotine is a combustible liquid. Its vapor can form explosive mixtures with air at elevated temperatures.
- B. Nicotine must be stored in tightly closed containers in a cool, well ventilated area away from strong oxidizers and strong acids.
- C. Sources of ignition such as smoking and open flames are prohibited wherever nicotine is handled, used or stored in a manner that could create a potential fire or explosion hazard.
- D. You must immediately remove any non-impervious clothing that becomes contaminated with nicotine and this clothing must not be reworn until the nicotine is removed from the clothing.
- E. If your skin becomes contaminated with nicotine, you must immediately wash or shower with soap or mild detergent and water to remove any nicotine from your skin.
- F. You must not eat or smoke in areas where nicotine is handled, processed or stored.
- G. If you handle nicotine, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.
- H. Fire extinguishers, quick drenching facilities and eye flushing facilities, where provided, must be readily available and you should know where they are and how to operate them.
- I. Ask your supervisor where nicotine is released or 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 nicotine. In addition, your employer must instruct you in the safe use of nicotine, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to nicotine. 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.

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- C. Your employer is required to keep records of your exposure and medical examinations. Your employer is required to keep exposure data for at least one year and to keep medical data during your employment, and for a period of five years following your termination of employment. Your employer is required to make the exposure data available to you upon your request. Your employer is also required to release your medical records to your physician upon your written request.
- D. Your employer must give you a copy of the physicians written opinion for any physical examination required by this standard.

NOTE: The information contained in the following appendix for nicotine 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 nicotine, it is advisory in nature.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
FOR NICOTINE

- I. PHYSICAL AND CHEMICAL DATA
 - A. Substance Identification
 - 1. Synonyms: 3-(1-methyl-2-pyrrolidyl)pyridine
 - 2. Formula: C10H14N2
 - 3. Molecular weight: 162
 - B. Physical Data
 - 1. Boiling point (760 mm Hg): 266 C (511 F)
 - 2. Specific gravity (water = 1): 1.0
 - 3. Vapor density (air = 1 at boiling point of nicotine): 5.6
 - 4. Melting point: Less than -79 C (-110 F)
 - 5. Vapor pressure at 20 C (68 F): 0.0425 mm Hg
 - 6. Solubility in water, % by weight at 20 C (68 F): Miscible in all proportions below 60 C (140 F)
 - 7. Evaporation rate (butyl acetate = 1): Not applicable
 - 8. Appearance and odor: Pale yellow to dark brown liquid with a slight fishy odor when warm
- II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA
 - A. Fire
 - 1. Flash point: 95 C (203 F) (calculated)
 - 2. Autoignition temperature: 244 C (471 F)
 - 3. Flammable limits in air, % by volume: Lower: 0.7; Upper: 4.0
 - 4. Extinguishing media: Alcohol foam, carbon dioxide, dry chem.

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5. Special fire-fighting procedures: Do not use a solid stream of water since a stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Nicotine is a combustible liquid. At elevated temperatures its vapors can form explosive mixtures with air. All ignition sources must be controlled where nicotine is used, handled or stored in a manner that could create a potential fire or explosion hazard.
7. For purposes of complying with the requirements of 29 CFR 1910.106, nicotine is classified as a Class IIIB combustible liquid.

B. Reactivity

1. Conditions contributing to instability: None
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions. Contact with strong acids may cause violent spattering.
3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen and carbon monoxide) may be released in a fire involving nicotine.
4. Special precautions: Nicotine will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If nicotine is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. For small quantities, absorb on paper towells. Evaporate in a safe place (such as a fume hood). Allow sufficient time for vapor to completely clear the duct work, then burn the paper. Large quantities can be reclaimed or collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

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

C. Waste disposal methods: Nicotine may be disposed of by:

1. Absorbing in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.
2. 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 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 (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by

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collection of the particulates and vapors using a high efficiency membrane filter followed by an adsorption tube with subsequent chemical analysis of both the filter and adsorption tube. Detector tubes certified by NIOSH under 42 CFR part 84 or other direct-reading devices calibrated to measure nicotine may be used. The method of measurement must determine the concentration of nicotine 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 above. More than three (3) measurements should be taken during the work shift so that increased confidence may be placed in the judgement that the employee has or has not, in fact, been exposed in excess of the permissible limit. Samples should be collected as described in 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 nicotine 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 T" (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 nicotine in tightly closed containers in a cool, well ventilated area.

b. Use of supplied-air suits or other impervious coverings (such as acid suits) may be necessary to prevent skin absorption from nicotine. 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.

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

VI. COMMON OPERATIONS

Common operations in which exposure to nicotine is likely to occur are: During the extraction of nicotine from tobacco by steam distillation; during its use as an insecticide or as an intermediate in the preparation of derivatives for use as insecticides; during the harvesting, handling and processing of tobacco; during the smoking of all tobacco products; and during the use of snuff or chewing tobacco.

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

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

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption; ingestion.

II. TOXICOLOGY

Nicotine in solution causes a transient stimulation, followed by depression or paralysis of the central nervous system, peripheral autonomic ganglia, and nerve endings in skeletal muscle; it also directly stimulates smooth muscle. Many fatal human cases of nicotine intoxication have occurred, usually as a result of accidental or suicidal ingestion of nicotine insecticides. Nicotine is readily absorbed through the skin; in fatal cases of intoxication death nearly always occurs within 1 hour and has occurred within 1 minute; the fatal adult dose is about 60 mg. Symptoms include nausea, salivation, abdominal pain, vomiting, diarrhea, cold sweat, headache, dizziness, disturbed hearing and vision, confusion, weakness, and incoordination. Initially, respiration is deep and rapid, blood pressure is elevated, and the pulse is slow; intense vagal stimulation may cause transient cardiac standstill or paroxysmal atrial fibrillation; the pupils are generally constricted. Excitation of the central nervous system results in tremor and sometimes clonic-tonic convulsions. As central nervous system depression ensues the pupils dilate, the blood pressure falls, and the pulse becomes rapid and often irregular; faintness, prostration, dyspnea, and paralysis of respiratory muscles are followed by death. Recovery usually occurs if the victim survives 1 to 4 hours. Skeletal system malformations occurred in the offspring of pregnant mice injected subcutaneously with nicotine between days 9 to 11 of pregnancy.

III. SIGNS AND SYMPTOMS

Nausea, salivation, abdominal pain, vomiting, diarrhea; headache, dizziness, disturbed hearing and vision, confusion, weakness, incoordination; paroxysmal atrial fibrillation; convulsions; faintness, prostration, dyspnea.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

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Remove from exposure. Immediately flush eyes and skin with water. If swallowed and the person is conscious, induce vomiting. Give artificial resuscitation and administer oxygen if indicated. Observe for convulsions and initiate appropriate treatment.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Nicotine may be rapidly fatal. The complex effects result from its actions on a variety of neuroeffector synapses and its stimulant and depressant phases of action. Since it is teratogenic in mammalian animals, the advisability of exposure of women of child bearing age should be considered. Skin absorption is rapid and a major route of entry. It is important that the physician become familiar with plant operating conditions in which exposure to nicotine 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 nicotine:

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

C. PERIODIC EXAMINATIONS

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

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Nicotine," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 181.
2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 2193-2196.
3. Gleason, M.N., et al: Clinical Toxicology of Commercial Products (3d ed.), Williams and Wilkins Company, Baltimore, 1969, Section III, pp. 168-171.

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4. Goodman, Louis S. and Alfred Gilman: The Pharmacological Basis of Therapeutics (5d ed.), The Macmillan Publishing Company, Inc., New York, 1975, pp. 567-574.

5. Nishimura, H. and K. Nakai: "Developmental Anomalies in Offspring of Pregnant Mice Treated with Nicotine," Science, 127:877-878, 1958.

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REFERENCES AND SOURCES

NICOTINE

1910.1000

- (f) Personal Protective Equipment, and, (h) Sanitation
Eye: Grant, "Toxicology of the Eye"
Skin: American Conference of Governmental Industrial Hygienists,
"Documentation of the Threshold Limit Values for Substances
in Workroom Air;" Gleason, "Clinical Toxicology of Commercial
Products;" Thienes and Haley, "Clinical Toxicology;"
Stolman, "Progress in Chemical Toxicology;" Patty, "Industrial
Hygiene and Toxicology;" International Labour Office,
"Encyclopedia of Occupational Health and Hygiene;" Christensen,
"NIOSH Toxic Substances List"
Ingestion: American Conference of Governmental Industrial Hygienists,
"Documentation of Threshold Limit Values for Substances in
Workroom Air;" Gleason, "Clinical Toxicology of Commercial
Products;" Patty, "Industrial Hygiene and Toxicology;" Stolman,
"Progress in Chemical Toxicology;" Thienes and Haley, "Clinical
Toxicology;" Comm. of Penn, "Hygienic Information Guide No.
37;" Gleason, "Clinical Toxicology of Commercial Products;"
Christensen, "NIOSH Toxic Substances List"

COMMENTS

Eye - Classification: 1

Output statement numbers: 9, 13

Exceptions: None

According to Grant, "in one instance a splash of pure nicotine base in a patient's eye caused severe pain, much conjunctival reaction and corneal infiltration. Eventually the eye healed with partial opacification of the cornea. Experimentally, nicotine injected into the anterior chamber of rabbits has caused inflammation of the anterior segment of the eye and miosis."

Other pertinent data could not be found. Since the case described above resulted in presumably permanent partial opacification, and since nicotine is a serious hazard by skin absorption, it is concluded that a classification of 1 is warranted.

Skin - Classification: 1

Output statement numbers: 1, 6, 8a, 14g, 14i, 20a

Exceptions: None

The ACGIH notes that "the toxicology of nicotine has been studied intensively; . . . many cases of poisoning from nicotine itself have been recorded, the majority resulting from ingestion or absorption through the skin. Fatal cases of occupational poisoning have been relatively uncommon, but milder cases, with vomiting and diarrhea the predominant symptoms, have not been unusual among chemical processors and insecticide applicators."

According to Gleason, "nicotine is one of the most toxic of all poisons and acts with great rapidity. It is absorbed from the . . . intact skin. Percutaneous absorption is many times faster with the free alkaloid than with its

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acid salts. The major effects of nicotine, aside from local caustic actions, are a transient stimulation and subsequent depression or paralysis of the central nervous system, all peripheral autonomic ganglia, and nerve endings in skeletal muscles. In addition smooth muscle cells are perhaps directly excited by the alkaloid, an action which may be partly responsible for the observed vasoconstriction and intestinal movements . . . In fatal cases of nicotine poisoning, death is usually rapid; it occurs nearly always within 1 hour and occasionally within 5 minutes."

Thienes and Haley report that nicotine is rapidly absorbed from the skin and that "agriculture workers exhibit symptoms, often alarming, due . . . to cutaneous absorption. Nicotine causes stimulation not only of the brain but also of the visceral ganglia; toxic doses causes secondary depression. Symptoms are dizziness, nausea, cold perspiration, vomiting, pallor, excitement, general weakness, purging, slowing or acceleration of the heart, increased cardiac output up to 188%, mental confusion, convulsions, respiratory embarrassment, fibrillary twitching and loss of consciousness."

Stolman states that "nicotine is highly toxic to mammals by . . . dermal application, and it is rapidly absorbed by the skin. Depression and nausea occur in workers using 0.1% nicotine solutions for spraying."

According to Patty, "nicotine is locally irritating. The free alkaloid is absorbed rapidly through the skin, but absorption of its acid salts is less complete." The estimate dermal LD50 for the rabbit is 50 mg/kg.

The ILO reports "nicotine is a very toxic substance, and serious or fatal poisoning may occur as the result of . . . skin absorption of only very small amounts. . . Nicotine acts on the nervous system of exposed animals, initially as a stimulant and subsequently as a depressant. Paralysis ensues in a short space of time and results in failure of organic functions . . ."

Christensen gives to skin LD50 for the rat as 140 mg/kg, and for the rabbit as 50 mg/kg.

Nicotine has a vapor pressure of 0.0425 mm Hg at 20 degrees C, a boiling point of 511 degrees F. It is miscible in water in all portions below 60 degrees C (140 F).

The skin absorption LD50 for this substance is extremely low. The compound is, therefore, assigned a classification of 1.

Ingestion - Classification: 1

Output statement numbers: 19, 20a

Exceptions: None

The ACGIH reports, "according to Fairhall, there were 487 deaths from nicotine poisoning in the United States between 1934 and 1950. Fatal cases of occupational poisoning have been relatively uncommon, but milder cases, with vomiting and diarrhea the predominant symptoms, have not been unusual

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among chemical processors and insecticide applicators. Wilson and DeEds found that a diet containing 60 ppm of nicotine inhibited the growth of rats. The fatal human dose has been estimated at 60 mg, but a toxic effect (nausea) can result from 2 to 5 mg."

According to Gleason, "nicotine is one of the most toxic of all poisons and acts with great rapidity . . . Taken by mouth the mean lethal dose of nicotine is about 60 mg in an adult (1 mg/kg), but a few milligrams may produce a severe illness and even death . . . The ingestion of as much as 2 gm of nicotine in an insecticide solution has been survived. In fatal cases of nicotine poisoning, death is usually rapid; it occurs nearly always within 1 hour and occasionally within 5 minutes. According to the traditional point of view, death is due to paralysis of the respiratory muscles. Paralysis of medullary centers controlling respiration requires a large dose. Nicotine first stimulates and later depresses the central nervous system to produce tremors, then clonic convulsions, followed by tonic-extensor convulsions and death."

According to Patty, "the major action of nicotine is that of primary transient stimulation and a secondary depression of the central nervous system and all sympathetic and parasympathetic ganglia through its direct action on the ganglion cells. It appears that nicotine initially stimulates by depolarizing ganglionic cells and then prevents transmission by competitive blockade of acetylcholine."

Stolman reports "the fatal dose of pure nicotine is about 40 mg; death occurs within 5 - 30 minutes . . . Nicotine residues are dangerous: 60 ppm inhibits growth of rats; 500 ppm is fatal. Nicotine causes a primary transient stimulation followed by a depression of all nerve ganglia. Symptoms of an acute intoxication include burning of the mouth, throat, and stomach; nausea; diarrhea; collapse with or without tonic and clonic convulsions; and finally death by a curare-like respiratory failure." Stolman also reports that "nicotine is rapidly absorbed from the bladder. When placed in the bladder of dogs in 10, 25 and 50 mg/kg doses, changes in the blood pressure, respiration and electrocardiogram were noted in 2 minutes."

Thienes and Haley state that "one mg of nicotine will cause marked symptoms in one unaccustomed to its action; 10 mg may be fatal to a child, 65 mg to an adult. One drop of the liquid nicotine weighs 23 to 33 mg . . . Swallowing of nicotine causes severe irritation of mouth, esophagus and gastric mucosa. Death is due to respiratory failure, either by a curare-like paralysis of the respiratory muscles or by medullary depression."

The Hygienic Information Guide No. 37 reports "nicotine is an exceedingly dangerous poison which is effective in very small quantities. A 50 milligram total dose has been known to be rapidly fatal to man. . . Systemic

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poisoning can be acute or chronic . . . After absorption the drug is a stimulant, then a paralyzant of the central nervous system, causing muscular weakness, convulsions, salivation, nausea, vomiting and abdominal pain. Continued exposure can also give rise to mental confusion, loss of reflexes, dizziness and collapse. Fatalities are usually caused by respiratory paralysis."

Gleason gives the "probable lethal dose by ingestion" as "about 0.6 to 0.9 mg/kg in man." Christensen lists the oral LD50 for the dog as 9200 mg/kg.

The substance obviously is super toxic and deserves a classification of 1.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

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

Chemical Formulators, Inc., Technical Bulletin, "Nicotine Insecticide," (Chem)

K. E. Jackson, "Chem. Rev. 29," p. 124, 1941 (Jack)

Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 11, p. 683 (K-O)

Sources of data items used:

- I. A. 1. Synonyms: Chem
- 2. Formula: NFPA-325M
- 3. Molecular weight: ADL
- B. 1. Boiling point: Jack
- 2. Specific gravity: NFPA-325M, Chem
- 3. Vapor density: NFPA-325M
- 4. Melting point: Jack
- 5. Vapor pressure: K-O
- 6. Solubility in water: Jack
- 7. Evaporation rate: Not applicable
- 8. Appearance and odor: Chem, Jack
- II. A. 1. Flash point: Data not available
- 2. Autoignition temperature: NFPA-325M
- 3. Flammable limits: NFPA-325M
- 4. Extinguishing media: NFPA-325M, ADL
- 5. Special fire fighting procedures: ADL
- 6. Unusual fire and explosion hazards: NFPA-325M, ADL
- B. 1. Conditions contributing to instability: ADL
- 2. Incompatibilities: ADL
- 3. Hazardous decomposition products: ADL
- 4. Special precautions: ADL
- III. A. Steps if released or spilled: ADL
- C. Waste disposal method: ADL
- V. Miscellaneous precautions: ADL

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

Gindhart, F. D., "Nicotine Poisoning," Industrial Medicine, 8:515 - 516, 1939 (Gindhart)

International Labour Organization, "Encyclopedia of Occupational Health," Geneva, 1972 (ILO)

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Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience Publishers, Division of John Wiley, 2nd edition, 1972 (K-O)
"Nicotine," Hazard Process Index, Hazard Entry No. 135, Contract HSM-99-73-62, National Institute of Occupational Safety and Health (HPI)
"Nicotine," Hygienic Information Guide No. 37, Commonwealth of Pennsylvania, Department of Health, Division of Occupational Hygiene, 1/70 (Penn)
Patty, F. A., "Industrial Hygiene and Toxicology," vol. II, Interscience Publishers, 1962 (Patty)
Thienes, C. H. and Haley, T. J., "Clinical Toxicology," 5th edition, Lea and Febiger, 1972 (Thienes and Haley)
U.S. Environmental Protection Agency, "EPA Compendium of Registered Pesticides," vol. III, "Insecticides, Acaricides, Molluscicides, and Antifouling Compounds," Office of Pesticide Programs (EPA)

References for Specific Use/Exposure

1. Thienes and Haley, Patty, EPA, Gindhart
2. Patty, ILO
3. HPI, K-O, Penn
4. Penn, Thienes and Haley

References for Specific Control Methods

ILO and Penn were the references used in all of the Specific Control Methods.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Nicotine

D. O. L. STANDARD: 0.5 mg/M3

WARNING PROPERTIES:

Odor Threshold: There is no quantitative information available concerning the odor threshold of nicotine.

Eye Irritation Level: Grant states that "in one instance a severe pain, much conjunctival reaction and corneal infiltration. Eventually the eye healed with partial opacification of the cornea." For the purposes of this standard, half-facepiece respirators are permitted unless eye irritation occurs. If eye irritation occurs, a full facepiece respirator must be worn.

Evaluation of Warning Properties: Since there is no quantitative information available relating warning properties to air concentrations of nicotine, this substance is treated as a material with poor warning properties. Gas sorbent respiratory equipment is not permitted.

IDLH: 35 mg/M3

Basis for IDLH Value: There are no acute inhalation toxicity data available upon which to base the IDLH for nicotine. The chosen IDLH, therefore, has been estimated from the human oral lethal dose of 60 mg given both in Patty and in the Documentation of TLV's.

Other Toxicological Information: Patty states that "nicotine is highly toxic. It is absorbed from the gastrointestinal tract, respiratory tract, and the skin . . . Many fatal human cases of nicotine intoxication have occurred, usually as a result of accidental or suicidal ingestion of nicotine insecticides. There were 288 such fatalities reported in the United States in the 5-year period from 1930 to 1934. Intoxications have also been described in persons engaged in nicotine extraction and in spraying insecticides. Considering the relatively enormous use of nicotine, occupational intoxications have been infrequently recorded. The symptoms that have been described

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in man are quite varied, as would be expected from the complex and phasic pharmacological actions of nicotine. The mild symptoms of nicotine absorption have been experienced by most of those persons who have smoked tobacco for the first time or after a period of abstinence. The common symptoms of moderate intoxication include nausea, vomiting, abdominal pain, diarrhea, headache, sweating, palpitation, and fatigue. More severe symptoms are faintness, dizziness, weakness, and confusion progressing to prostration with increasing muscular weakness, collapse, and respiratory arrest. Most deaths occur within a few minutes of ingestion and recovery usually occurs if the patient survives 1 to 4 hours. It has been estimated that approximately 60 mg of nicotine orally would be fatal to most adults." Grant reports that "as little as 40 mg may be fatal for a man."

According to the Documentation of TLV's "Wilson and DeEds found that a diet containing 60 ppm of nicotine inhibited the growth of rats. The fatal human dose has been estimated at 60 mg, but a toxic effect (nausea) can result from 2 to 5 mg.

"The TLV of 0.5 mg/M3, representing at most an intake of 5 mg over an eight-hour period, should not result in any significant ill effects."

Patty gives a rabbit, skin absorption LD50 of 50 mg/kg.

VAPOR PRESSURE AT 20 C: 0.0425

SATURATED CONCENTRATION AT 20 C: Approximately 55.9 ppm or 370 mg/M3

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	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor or dust and skin contact with vapor or liquid during application of pesticides and fumigants (including vegetable crops, strawberries, grass and turf, flowering plants, shrubs, and greenhouse plants)	A,D	Personal protective equipment (respiratory protective equipment, impervious protective clothing)
2.	Inhalation of dust or vapor and skin contact with vapor or liquid during extraction and handling of substances	A,D	Process enclosure; local exhaust ventilation; general mechanical ventilation; personal protective equipment (respiratory protective devices, impervious protective clothing)
3.	Inhalation of vapor or dust and skin contact with vapor or liquid during formulation of pesticide products and fumigants (including solutions, dusts, emulsions, and sprays)	A,D	Process enclosure; local exhaust ventilation; general mechanical ventilation; personal protective equipment (respiratory protective devices, impervious protective clothing)
4.	Inhalation of vapor or dust and skin contact with vapor or liquid during processing of tobacco in manufacture of tobacco products	A,D	Process enclosure; local exhaust ventilation; general mechanical ventilation; personal protective equipment (respiratory protective devices, impervious protective clothing)

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