

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** ANILINE ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for ANILINE

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 ANILINE.

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 aniline not in excess of 5 parts per million (ppm) (19 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 aniline.

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

(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 aniline;

(ii) Any measurements of aniline taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to aniline; 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 aniline 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 aniline 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 aniline 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 aniline 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 aniline 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 aniline 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
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Above permissible exposure	$\pm 25\%$
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At or below permissible exposure and above the action level	$\pm 35\%$
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At or below the action level	$\pm 50\%$
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(d) Compliance. (1) No employee shall be exposed to aniline above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of aniline 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. (1) 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 aniline.

(ii) In the design of open surface tank ventilation for the purposes of § 1910.94(d), operations involving aniline shall be classified as A-4 at 70 degrees F (21 degrees C).

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

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

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

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

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- (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 ANILINE

CONDITION	PERMISSIBLE RESPIRATOR PROTECTION
Vapor Concentration	
100 ppm or less	Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s). ----- A gas mask with a chin-style or a front- or back-mounted organic vapor canister. ----- Any supplied-air respirator with a full facepiece, helmet or hood. ----- Any self-contained breathing apparatus with a full facepiece. -----
Greater than 100 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. -----

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Any escape self-contained breathing apparatus.

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

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

(e) Fire and safety. (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for aniline.

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

(3) For the purpose of compliance with § 1910.157, aniline 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 aniline shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid aniline is classified as a Class IIIA combustible liquid.

(6) Dip tank operations shall be performed in accordance with §§ 1910.108 and 1910.94(d).

(7) Where a fan is located in ductwork and where aniline is present in the ductwork in concentrations greater than 3300 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.

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

(9) Aniline shall be stored so as not to come in contact with strong oxidizers or strong acids.

(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 skin contact with liquid aniline, where contact may occur. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

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

(3) Where exposure of an employee's body to liquid aniline 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 non-impervious clothing which becomes contaminated with aniline be removed immediately and not reworn until the aniline is removed from the clothing.

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(5) Employers shall provide and ensure that employees use splash-proof safety goggles (cup-cover type dust and splash safety goggles) which comply with § 1910.133 (a)(2)-(a)(6) where liquid aniline may contact the eyes.

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

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

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

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

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

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

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

(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 aniline or airborne concentrations of aniline at or above the action level, a medical examination which shall include the following:

(i) A medical history and physical examination with emphasis on the blood, liver, cardiovascular system and kidneys.

(ii) A complete blood count to include at least red and white cell count, differential smear, hemoglobin and hematocrit.

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

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

(ii) A record of the results of the complete blood count.

(4) The employer shall make available to each employee, exposed to aniline 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

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the action level thereafter, a medical examination which must include the following:

(i) A medical history and physical examination with emphasis on the blood, liver, cardiovascular system and kidneys.

(ii) A complete blood count to include at least red and white cell count, differential smear, hemoglobin and hematocrit.

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

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

(ii) A record of the results of complete blood count.

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

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

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

(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 aniline or would directly or indirectly aggravate any detected medical condition;

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

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

(8) No employee shall be exposed to liquid aniline or airborne concentrations of aniline 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 aniline.

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

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

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

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

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

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

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

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

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

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to aniline 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.

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(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 aniline;

(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.

(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 aniline which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to aniline 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 aniline 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

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SUBSTANCE SAFETY DATA SHEET
FOR ANILINE

I. SUBSTANCE IDENTIFICATION

- A. Substance: Aniline
- B. Permissible Exposure: 5 parts of aniline per million parts of air (ppm) (19 milligrams of aniline per cubic meter of air, (mg/M3)) averaged over an eight-hour work shift.
- C. Appearance and Odor: Colorless to brown oily liquid with weak amine odor.

II. HEALTH HAZARD DATA

- A. Ways in Which the Chemical Affects Your Body: Aniline can affect your body if you inhale it, if it comes in contact with your eyes or skin, or if you swallow it. It is readily absorbed through your skin, either as a liquid or vapor. Even a small amount absorbed from the clothes or shoes may cause toxic symptoms.
- B. Effects of Overexposure:
 - 1. Short-Term Exposure: Aniline affects the ability of blood to carry oxygen. Moderate exposure to aniline may cause only a bluish discoloration of the skin. As oxygen deficiency increases the blue discoloration may be associated with headache, weakness, irritability, drowsiness, shortness of breath, and unconsciousness. If treatment is not given promptly death can occur. Aniline is irritating to the eyes and may cause eye damage. The onset of symptoms may be delayed.
 - 2. Long-Term Exposure: Repeated skin or respiratory exposure to aniline may cause headache, irritability, insomnia, dizziness, decreased appetite, paleness and anemia.
 - 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 aniline.

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If aniline gets into your eyes, wash your eyes immediately, gently but thoroughly 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 aniline gets on your skin, promptly wash the contaminated skin using soap or mild detergent and water. If aniline soaks through your clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. Get medical attention promptly.
- C. Breathing: If you or any other person breathes in large amounts of aniline 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 aniline 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

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- 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.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

- A. Respirators: Respirators are not the best way to control exposure to aniline. 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 aniline 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 skin contact with liquid aniline, where contact may occur. Replace or repair impervious clothing that has developed leaks.
- D. Eye Protection: You must wear splash-proof safety goggles where liquid aniline may contact your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. Aniline is a combustible liquid and its vapors can form explosive mixtures with air at elevated temperatures.
- B. Aniline must be stored in tightly closed containers in a cool, well ventilated area away from heat, sparks, flames, strong oxidizers, and strong acids.
- C. Sources of ignition such as smoking and open flames are prohibited wherever aniline 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 aniline and this clothing must not be reworn until the aniline is removed from the clothing.
- E. If your skin becomes contaminated with aniline, you must immediately wash or shower with soap or mild detergent and water to remove the aniline from your skin.

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- F. You must not eat or smoke in areas where liquid aniline is handled, processed or stored.
- G. If you handle liquid aniline, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.
- 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 aniline 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 aniline. In addition, your employer must instruct you in the safe use of aniline, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to aniline. You or your representative have the right to observe employee exposure measurements and to record the results obtained. If your employer determines that you are being overexposed, he is required to inform you of the exposure and of the actions which are being taken to reduce your exposure.
- C. Your employer is required to keep records of exposure determinations, exposure measurements, and medical surveillance. Your employer is required to make records of exposure determinations and your exposure measurements available to you or your representative upon your request. Your employer is required to release your medical records to your physician upon your written request.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
FOR ANILINE

I. PHYSICAL AND CHEMICAL DATA

- A. Substance Identification
 - 1. Synonyms: Aminobenzene; phenylamine; aniline oil
 - 2. Formula: $C_6H_5NH_2$
 - 3. Molecular weight: 93.1
- B. Physical Data
 - 1. Boiling point (760 mm Hg): 184 C (364 F)
 - 2. Specific gravity (water = 1): 1.022
 - 3. Vapor density (air = 1 at boiling point of aniline): 3.22
 - 4. Melting point: -6.2 C (21 F)
 - 5. Vapor pressure at 20 C (68 F): 0.6 mm Hg

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6. Solubility in water, % by weight at 20 C (68 F): 3.5
7. Evaporation rate (butyl acetate = 1): Less than 1
8. Appearance and odor: Colorless to brown oily liquid with a weak amine odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 70 C (158 F) (closed cup)
2. Autoignition temperature: 615 C (1139 F)
3. Flammable limits in air, % by volume: Lower: 1.3; Upper: Data not available
4. Extinguishing media: Carbon dioxide, alcohol foam, dry chemical
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: Aniline is a combustible liquid. At elevated temperatures its vapors can form explosive mixtures with air. All ignition sources must be controlled where aniline 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, aniline is classified as a Class IIIA combustible liquid. For example, 3300 ppm, approximately one-fourth of the lower flammable limit, is one situation in which aniline 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 aniline shall be Class I Group D.

B. Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact of liquid with strong acids will cause violent spattering. Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen and carbon monoxide) may be released in a fire involving aniline.
4. Special precautions: Liquid aniline will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

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

1. Ventilate area of spill or leak.
2. For small quantities, absorb on paper towels. Remove to a safe place (such as a fume hood) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

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- B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.
- C. Waste disposal methods: Aniline may be disposed of:
 - 1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.
 - 2. 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 aniline 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 aniline 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 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 aniline in tightly closed containers in a cool, well-ventilated area.
- B. Use of supplied-air suits or other impervious coverings may be necessary to prevent skin contact with aniline where the concentration of aniline is unknown or is greater than 100 ppm. Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons

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knowledgeable in the limitations and potential life endangering characteristics of supplied-air suits.

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

VI. COMMON OPERATIONS

Common operations in which exposure to aniline is likely to occur are: during its production and its use as an intermediate in the synthesis of dyes, rubber chemicals, pharmaceuticals, photographic chemicals, sweeteners, isocyanates, agricultural chemicals, corrosion inhibitions, etc; and during the handling and use of aniline-containing inks.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. TOXICOLOGY

Aniline absorption, whether from inhalation of the vapor or skin absorption of the liquid, causes anoxia due to the formation of methemoglobin. Rats exposed to 5 ppm of vapor daily for six months showed no effects other than slight methemoglobinemia. Human exposure to vapor concentrations of 7 ppm has been observed to cause slight symptoms. Rapid absorption through the intact skin is frequently the main route of entry; a small amount absorbed from contaminated clothing or shoes may cause intoxication, characterized by cyanosis. Following skin absorption, the onset of symptoms may be delayed for up to 4 hours. Headache is commonly the first symptom and may become quite intense as the severity of methemoglobinemia progresses. Cyanosis develops early in the course of intoxication, first in the lips, the nose and the ear lobes, usually recognized by fellow workers. Cyanosis occurs when the methemoglobin concentration is 15 per cent or more. The individual usually feels well, has no complaints, and may insist that nothing is wrong, although cyanosis is evident to observers, until the methemoglobin concentration approaches approximately 40 per cent. At methemoglobin concentrations of over 40 per cent, there usually is weakness and dizziness; up to 70 per cent concentration, there may be ataxia, dyspnea on mild exertion and tachycardia. The development of intravascular hemolysis and anemia due to aniline-induced methemoglobinemia has been postulated, but neither is observed often in industrial practice despite careful and prolonged study of numerous cases. Occasional deaths from asphyxiation caused by severe aniline intoxication are said to have occurred. Liquid aniline is mildly irritating to the eyes and may cause corneal damage.

III. SIGNS AND SYMPTOMS

Headache; weakness, dizziness; cyanosis; ataxia, dyspnea on effort; tachycardia; eye irritation.

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IV. SPECIAL TESTS

Methemoglobin concentration in the blood should be determined when aniline intoxication is suspected, and at regular intervals until it has been fully reduced to normal hemoglobin.

V. TREATMENT

Remove from exposure. If swallowed and the person is conscious, induce vomiting. Give artificial resuscitation or oxygen if indicated. Any aniline on the body must be removed. Immediately remove all contaminated clothing, including shoes, and wash entire body with plenty of soap or mild detergent and water. Scrub hands. Shampoo hair and scalp. Clean finger and toe nails. Clean nostrils and ear canals. Give oxygen and confine to bed. In case of eye splashes, flush with water. Determine methemoglobin in blood and repeat every 3 to 6 hours for 18 to 24 hours. Repeat showers and skin cleansing if methemoglobin appears to rise after 3 to 4 hours. Consideration may be given to the intravenous administration of methylene blue at high levels of methemoglobinemia in an attempt to accelerate the conversion of methemoglobin to hemoglobin; however, the use of this agent is controversial due to its toxic effects.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of aniline are caused by its capacity to produce cyanosis due to formation of methemoglobin. It readily penetrates shoes, clothing, and leather gloves, so that a small area of contamination on clothing or gloves will produce evidence of poisoning if left in contact with the skin for several hours since skin absorption is known to occur. It is important that the physician become familiar with plant operating conditions in which exposure to aniline 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 aniline:

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 blood, cardiovascular system, liver, and kidney should be stressed.
2. Complete blood count -- This substance has been shown to cause methemoglobinemia. A complete blood count must be performed to include red and white cell count, a differential

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count of a stained blood smear, as well as hemoglobin and hematocrit.

C. PERIODIC EXAMINATIONS

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

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Aniline," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, pp. 13-14.
2. Hygienic Guide Series: "Aniline," American Industrial Hygiene Association Journal, 16:331-332, 1955.
3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 2105-2120, 2123-2127, 2132, 2133, 2242.
4. Manufacturing Chemists Association, Inc.: Chemical Safety Data Sheet SD-17, Aniline, Washington, D.C., 1963, pp. 13-14.
5. Mangelsdorff, A.F.: "Treatment of Methemoglobinemia," AMA Archives of Industrial Health, 14:148-153, 1956.

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REFERENCES AND SOURCES

ANILINE

1910.93

- (d) Compliance - Open surface tanks classification based on relative evaporation rate of 190 hours (from Doolittle.)
- (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. 9.
- (f) Personal Protective Equipment, and, (h) Sanitation
- Eyes: MCA, Chemical Data Sheet; Grant, "Toxicology of the Eye"
- Skin: MCA, Chemical Data Sheet; AIHA, Hygienic Guide Series, "Aniline;" Gleason, "Clinical Toxicology of Commercial Products;" ILO, "Encyclopedia of Occupational Health and Safety;" PHS-149, "Survey of Compounds That Have Been Tested for Carcinogenic Activity;" Sax, "Dangerous Properties of Industrial Materials;" Dutkiewicz, "Aniline Vapor Absorption in Man," Medyeyna Pracy, Warsaw, Poland, Feb. 1961, p. 1 - 11; Casciano, "Acute Methemoglobinemia Due to Aniline - A Report of a Case," Journal of the Med. Soc. of N.J., 49:4, p. 141 - 2; Scarpa and Ferria, "Group Variation in Reactivity to Common Contact Allergens," Archives of Dermatology, Vol. 94, p. 589 - 591
- Ingestion: MCA, Chemical Data Sheet; Gleason, "Clinical Toxicology of Commercial Products;" Sax, "Dangerous Properties of Industrial Materials;" Jenkins et al., "The No-Effect Dose of Aniline in Human Subjects and a Comparison of Aniline Toxicity in Man and the Rat," Food and Cosmetics Toxicology, Vol. 10, p. 671 - 679

COMMENTS

Eyes - Classification: 2

Output statement numbers: 10

Exceptions: None

MCA states "aniline is mildly irritating to the eyes and may cause corneal damage." Grant summarizes that "it seems fair to conclude from the available evidence that it is doubtful that aniline poisoning has a specific effect on the eye, apart from the discoloration of the blood seen in the vessels of conjunctiva and fundus; industrial instances of conjunctival and corneal discoloration are attributable to accompanying or contaminating quinones. A classification of 2 is concluded to be sufficient. It is inferred that the possible corneal damage being referred to by MCA is actually the discoloration caused by absorption into the blood vessels of the eye. Reports of other types of eye "damage" could not be found in the literature.

Skin - Classification: 2

Output statement numbers: 2, 7a, 8b, 14g, 14i, 20a

Exceptions: See below

MCA states that "toxic levels may be reached in the blood and tissues by absorption through the intact skin."

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Continuing, it is noted "repeated skin exposure to low concentrations of aniline may produce headache, irritability, dizziness, insomnia, decreased appetite, pallor and low grade secondary anemia; the blood may contain methemoglobin, the red cells may show Heinz bodies and aminophenol may be present in the urine." MCA concludes that "all clinical and laboratory manifestations disappear with no permanent residual pathology demonstrable upon complete cessation of exposure." The symptoms of a more moderate exposure are described as cyanosis with no subjective symptoms although "there may be a temporary sense of well being or exhilaration due to the slight decrease in oxygen in the blood." Methemoglobinemia may follow. In severe exposures, death may result, according to MCA. The Hygienic Guide rates the hazard from skin exposure as high, adding the "chronic hazard is nil and of doubtful existence." Gleason reports two cases of aniline poisoning in which the substance penetrated the intact skin; symptoms were delayed 2 - 4 hours after initial skin contact and included weakness, headache, deep cyanosis, vomiting and collapse with stupor. The cutaneous LD50 for guinea pigs is set at 1.06 g/kg of 10% solution. The ILO states that "severe and/or long-continued exposure to aniline may result in some degree of haemolysis of the red blood cells." It is also noted that "chronic aniline poisoning does not exist as a separate entity; acute poisoning resulting from massive exposure, or prolonged subacute poisoning from continuing exposure, may bring about a secondary anemia by inducing haemolysis (which) represents the continuous summation of the acute and subacute effects." Aniline is not carcinogenic, according to ILO but two experiments reported in PHS-149 showed bladder tumor production following subcutaneous exposure. Sax lists the systemic hazard from acute and chronic skin absorption as severe. Experimental work by Dutkiewicz (abstract) showed that 75% of vapor absorption is through the skin. An abstract of a case reported by Casciano included the symptomatology and hospital therapy of a person who spilled 35 CC on his abdomen while distilling aniline. The venous blood was brown in color, the skin was darkened in color and the patient experienced weakness and a dull headache; recovery was complete in ten days. An abstract of a paper by Scarpa and Ferrea shows that skin contact with aniline produces an allergic reaction. The flashpoint of the substance is 70 C (158 F). Its vapor pressure is but 0.6 mm Hg at 20 C and it is 3.5% soluble in water. A classification of 2 is concluded to be appropriate if statement 2 is modified to prevent contact where it "may occur," and statements 14g and 14i are used instead of those numbered 16 or 17 to ensure that harmful amounts are not absorbed through the skin before action is taken.

Ingestion - Classification: 1

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Output statement numbers: 19, 20a

Exceptions: None

MCA states "toxic levels may be reached in the blood and tissues by ingestion of the liquid." The clinical picture varies according to the degree of exposure. According to MCA "moderate exposure to aniline may cause cyanosis, with no subjective symptoms; however, there may be a temporary sense of well being or exhilaration due to the slight decrease of oxygen in the blood." As more methemoglobin is formed, "the cyanosis may be associated with headache, weakness and irritability." MCA lists headache, palpitation, dizziness, drowsiness and shortness of breath as symptoms of a severe exposure, which may result in collapse and death. Gleason recounts a nonindustrial case of ingesting 80 ml reagent grade aniline; with treatment, the patient recovered. The absence of chronic effects is discussed above. Sax lists the systemic hazard from both acute and chronic ingestion as severe. In an abstract of work by Jenkins et al., it is reported that "no effect" was found when human volunteers ingested 5 - 15 mg of aniline. "Doses ranging from 25 to 65 mg significantly increased the blood level of methemoglobin but no Heinz bodies were observed." The extremely low doses required to produce the noted effects lead to the conclusion that a classification of 1 is warranted. This conclusion is supported by the recommendations of MCA.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

Manufacturing Chemists' Association, Chemical Safety Data Sheet SD-17 (MCA)

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

American Cyanamid Co., Product Data Sheet and Material Safety Data Sheet (Cyan)

E. I. duPont de Nemours and Co., Technical Data Bulletin (duP)

Sources of data items used:

- I. A. 1. Synonyms: MCA; Cyan
- 2. Formula: MCA
- 3. Molecular weight: duP
- B. 1. Boiling point: NFPA-325M; Cyan; MCA; duP
- 2. Specific gravity: MCA; NFPA-325M; duP; Cyan
- 3. Vapor density: MCA; NFPA-325M
- 4. Melting point: MCA; Cyan; duP
- 5. Vapor pressure: Cyan; duP
- 6. Solubility in water: duP
- 7. Evaporation rate: Cyan
- 8. Appearance and odor: MCA; NFPA-325M; Cyan
- II. A. 1. Flash point: MCA; NFPA-325; Cyan (duPont reports 75.5 F)
- 2. Autoignition temperature: NFPA-325M
- 3. Flammable limits: MCA; NFPA-325M; Cyan; duP
- 4. Extinguishing media: NFPA-49; MCA; Cyan

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- 5. Special fire fighting procedures: NFPA-49; Cyan
- 6. Unusual fire and explosion hazards: MCA
- B. 1. Conditions contributing to instability: ADL; Cyan
- 2. Incompatibilities: Cyan
- 3. Hazardous decomposition products: Cyan
- 4. Special precautions: ADL
- III. A. Steps if released or spilled: NFPA-49; MCA; ADL
- C. Waste disposal method: MCA; Cyan
- V. Miscellaneous precautions: MCA

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

- "Aniline," American Conference of Government Industrial Hygienists, Hygienic Guide Series, December 1955 (Hygienic Guides)
- "Aniline," Commonwealth of Pennsylvania Hygienic Information Guide No. 43, 5/72 (Pennsylvania)
- "Aniline," Hazard Process Index Hazard Entry No. 15, Contract No. HSM-99-73-62, National Institute of Occupational Safety and Health (HPI)
- "Aniline," Technical Information, duPont Chemical Products Division, Explosives Department, Wilmington (duPont)
- Ellis, C., "Printing Inks," Reinhold, New York, 1940 (Ellis)
- Graphic Arts International Union, "Background for Bargaining," 1974, GAIU, Washington, D. C. (GAIU)
- Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience Publishers, Division of John Wiley, 1st edition, 1954 (Chem Tech; 2nd edition, 1972 (K-O))
- Lefaux, R., "Practical Toxicology of Plastics," The Chemical Rubber Company, Cleveland, 1968 (Lefaux)
- McCormick, W. E., "Industrial Health Problems in the Rubber Industry," American Industrial Hygiene Association Quarterly, 13:37 - 41, 1952 (McCormick)
- Mosher, R. H. and Davis, D. S., "Industrial and Specialty Papers," Vol. I, Technology Chemical Publishing Company, Inc., 1968 (Mosher)
- Patty, F. A., "Industrial Hygiene and Toxicology," Vol. II, Interscience Publishers, 1962 (Patty)
- Stanford Research Institute, "Chemical Origins and Markets," SRI, Menlo Park, California, 1967 (Chem Origins)
- Watrous, R. M., "Health Hazards of the Pharmaceutical Industry," British Journal of Industrial Medicine, 4:111 - 125, 1947 (Watrous)

References for Specific Use/Exposure

- 1. Patty, K-O
- 2. McCormick, HPI, K-O
- 3. SRI
- 4. Patty, K-O, HPI
- 5. Watrous, Chem Tech
- 6. Patty, Chem Origins
- 7. Patty, HPI
- 8. Ellis, Patty, GAIU
- 9. Ellis, Patty
- 10. SRI
- 11. K-O, Mosher, Lefaux
- 12. Chem Origins, K-O

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13. HPI, K-0

14. K-0

References for Specific Control Methods

DuPont, Pennsylvania and Hygienic Guides were the references used in number 1 - 14..

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Aniline

D. O. L. STANDARD: 5 ppm

WARNING PROPERTIES:

Odor Threshold: Staub reports an odor threshold for aniline of 7 ppm; MCA reports that "the odor of aniline can usually be detected without difficulty in concentrations of 0.5 ppm, and Thienes and Haley report an odor threshold of 1 ppm.

Eye Irritation Level: MCA reports that "aniline is mildly irritating to the eyes and may cause corneal damage," but no quantitative information is given. Grant reports that "many years ago workers chronically exposed to crude aniline vapors had irritation of the eyes, photophobia, and impairment of vision," but Grant suggests that the disturbances of the cornea and conjunctiva which were observed might have been caused by "quinonelike oxidation products." Based upon the information reported by MCA, aniline is treated as an eye irritant for the purposes of this standard.

Evaluation of Warning Properties: Since the odor threshold ranges from a concentration well below the permissible exposure limit to a concentration only slightly greater than the permissible exposure limit, aniline is treated as a material with good warning properties. Gas sorbent respiratory equipment is permitted.

IDLH: 100 ppm

Basis for IDLH Value: This IDLH is based upon the report in the Documentation of TLV's that "concentrations in excess of 100 to 160 ppm cause serious disturbances if inhaled for one hour." The H. M. Factory Inspectorate in London reports similar information.

Other Toxicological Information: The ILO reports that the principal danger of occupational exposure to aniline is from inhalation or from skin absorption. Acute poisoning results in the formation of methemoglobin. Deichmann and Gerarde state that "in severe cases of intoxication, symptoms include marked cyanosis, a slow, bounding pulse, symptoms of air hunger, nausea and vomiting, low blood pressure, sudden and extreme prostration, and sometimes convulsions." Sax reports that "aniline may also have a direct toxic action, resulting in a fall in blood pressure and cardiac arrhythmia."

Carpenter et al. report that an exposure to 250 ppm for 4 hours is lethal to "2 out of 6, 3 out of 6, or 4 out of 6 rats."

The H. M. Factory Inspectorate of the Department of Employment and Productivity in London reports that within 1 hour, "severe toxic effects" would be produced by an exposure to 100 ppm aniline. Gradual poisoning would be produced by a continual exposure to 20 ppm aniline.

The AIHA Hygienic Guides do not give an IDLH concentration, but do report that "probably 50 - 100 parts per million can be tolerated for 60 minutes. This will depend on the extent of

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skin contact and also upon the susceptibility of the individual."

The Documentation of TLV's notes that "Henderson and Haggard cited data suggesting that 7 to 53 ppm of aniline vapor cause slight symptoms after several hours' exposure; concentrations in excess of 100 to 160 ppm cause serious disturbances if inhaled for one hour. Absorption through the skin is frequently the main route of entry of aniline into the body."

Spector reports a guinea pig skin penetration LD50 of 1060 mg/kg, with the aniline applied as a 10% solution.

LFL: 13,000 ppm

VAPOR PRESSURE AT 20 DEG. C.: 0.6 mm Hg

SATURATED CONCENTRATION AT 20 DEG. C.: 790 ppm

References: Carpenter, C. P., Smyth, H. F. and Rozzani, V. C., "The Assay of Acute Vapor Toxicity, and the Grading and Interpretation of Results on 96 Chemical Compounds," J. Ind. Hyg. and Tox., 31:343, 1949
H. M. Factory Inspectorate, "Methods for the Detection of Toxic Substances in Air - Aniline Vapour," Booklet No. 11, Department of Employment of Productivity, H. M. Stationery Office, P. O. Box 569, London SE1, 1968.

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USE/EXPOSURE AND CONTROL DOCUMENT
ANILINE

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor and skin contact with liquid during synthesis and handling of substance	A,D	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles)
2.	Inhalation of vapor and skin contact with liquid during chemical synthesis (and intermediates for chemicals) for rubber processing (including accelerators such as 2-mercaptobenzothiazole; antioxidants such as N-phenyl-2-naphthylamine and hydroquinone; and intermediates such as diphenylamine, acetanilide, dimethylaniline, and cyclohexylamine)	A,D	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles)
3.	Inhalation of vapor and skin contact with liquid during synthesis of diphenylmethane diamine in production of MDI (4,4'-methylene diphenyl isocyanate) and PMPPI (polymethylene polyphenyl isocyanate) in manufacture of rigid polyurethanes	A,D	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles)
4.	Inhalation of vapor and skin contact with liquid during synthesis of dyestuffs and intermediates for dyestuffs (including azo, pyrazolone, triphenylmethane, safranin, induline, nigrosins, oxazine, anthraquinone, indigo, thiazine, and azine dyes; and intermediates such as aniline hypochloride, cyclohexylamine, acetanilide,	A,D	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles)

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dimethylaniline, and
sulfanilic acid)

- | | | | |
|-----|--|-----|---|
| 5. | Inhalation of vapor and skin contact with liquid during synthesis of pharmaceuticals and intermediates for pharmaceuticals (acetanilide, arsanilic acid, sulfa drugs, dimethylaniline, cincophen) | A,D | Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles) |
| 6. | Inhalation of vapor and skin contact with liquid during synthesis of hydroquinone for photographic processing | A,D | Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles) |
| 7. | Inhalation of vapor and skin contact with liquid during synthesis of intermediates for agricultural chemicals (including phenothiazine and aromatic isocyanates for pesticide manufacture) | A,D | Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles) |
| 8. | Inhalation of vapor and skin contact with liquid during handling and application of inks containing aniline (including cloth marking ink, indelible ink for paper, lithographic and other printing inks) | A,D | Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles) |
| 9. | Inhalation of vapor and skin contact with liquid during manufacture of inks containing aniline (including cloth marking ink, indelible ink for paper, lithographic and other printing inks) | A,D | Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles) |
| 10. | Inhalation of vapor and skin contact with liquid during production of | A,D | Process enclosure; local exhaust ventilation; personal protective equipment |

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PACM monomer in
nylon fiber manufac-
ture

(respiratory protective
devices, gloves, goggles)

- | | | | |
|-----|--|-----|---|
| 11. | Inhalation of vapor and skin contact with liquid during synthesis of resins (including epoxy and amino resins) | A,D | Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles) |
| 12. | Inhalation of vapor and skin contact with liquid during synthesis of intermediates for artificial sweetening agents (including cyclohexylamine and M-nitroaniline) | A,D | Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles) |
| 13. | Inhalation of vapor and skin contact with liquid during synthesis of catalysts and stabilizers (including diphenylamine, dimethylaniline, and acetoniilide used as stabilizer for hydrogen peroxide and cellulose) | A,D | Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles) |
| 14. | Inhalation of vapor and skin contact with liquid during synthesis of corrosion inhibitors and use as a corrosion inhibitor | A,D | Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles) |

- 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 -----

1,430 CARDS READ

0 SYSOUT PRINT RECORDS

0 SYSOUT PUNCH RECORDS

0.00 MINUTES EXECUTION TIME

