NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND

SUPPORTING DOCUMENTATION FOR

*** TOLUENE ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for TOLUENE

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 TOLUENE.

The SCP draft technical standards are recommendations to the Department of Labor for its consideration in rulemaking and have no legal status until final rules have been promulgated by that agency. This draft standard is provided for your information only.

The References and Sources, Respirator Table Documentation and Use/Exposure and Control Documentation are the working documents used by the various SCP working groups during the development of the draft technical standard and serve as the technical foundation for the standard. The classification for each substance and the regulatory statements were derived following a decision logic established for the various sections of the standard.

(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of toluene (Toluol) not in excess of 200 parts of toluene per million (ppm), averaged over an eight-hour work shift. In addition, 300 ppm shall not be exceeded during an eight-hour work shift, except that a peak of 500 ppm is permitted for 10 minutes during the eight-hour work shift, as stated in $ 1910.1000. Table Z-2.

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

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

(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 toluene;

(ii) Any measurements of toluene taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to toluene; 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 toluene 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 toluene 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 toluene 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 toluene 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 toluene 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 toluene below the action level, the employer may terminate measurement for the employee.

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

(c) Methods of measurement. (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (See Appendix B (IV) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

Table 1

Concentration	Required Accuracy (Percent of True Value)
Above permissible exposure	± 25
At or below permissible exposure and above the action level	± 35
At or below the action level	± 50

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

(2) Employee exposures to airborne concentrations of toluene 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. (i) 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 toluene.

(ii) In the design of open surface tank ventilation for the purposes of § 1910.94(d), operations involving toluene shall be classified as C-2 at 21 degrees C (70 degrees F).

(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 toluene to at or below the permissible exposure; or

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

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided. If an employee informs his employer that he is experiencing eye irritation from toluene 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 TOLUENE (TOLUOL)

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Vapor Concentration	
500 ppm or less	Any chemical cartridge respirator with an organic vapor cartridge(s).
	Any supplied-air respirator.
	Any self-contained breathing apparatus.
1000 ppm or less	A chemical cartridge respirator with a full facepiece and organic vapor cartridge(s).
2000 ppm or less	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 2000 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.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

Escape	Any gas mask providing protection against organic vapors.
	Any escape self-contained breathing apparatus.

(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 toluene.

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

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

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

(6) Spray finishing operations shall be performed in accordance with $$ 1910.107 and 1910.94(c).

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

(8) Where a fan is located in ductwork and where toluene is present in the ductwork in concentrations greater than 3200 ppm (approximately 25% 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.

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

(10) Toluene shall be stored so as not to come in contact with strong oxidizers.

(f) Personal protective equipment. (1) Employers shall provide and ensure that employees use appropriate protective clothing and equipment necessary to prevent repeated or prolonged skin contact with liquid toluene. Face shields shall comply with $ 1910.133(a)(2),(a)(4), (a)(5), and (a)(6).

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

(3) Employers shall ensure that clothing which becomes wet with liquid toluene be removed immediately and not reworn until the toluene is removed from the clothing.

(4) Employers shall provide and ensure that employees use splash-proof safety goggles which comply with § 1910.133(a)(2)-(a)(6) where liquid toluene may contact the eyes.

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

(2) Liquid toluene shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive vapors are permitted.

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

(2) Employers shall ensure that employees who handle liquid toluene wash their hands thoroughly with soap or mild detergent and water before eating or smoking.

(i) Training and information. (1) Each employer who has a workplace in which toluene 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 toluene above the action level without regard to the use of respirators, or employees who may have repeated or prolonged skin contact, or who may have eye contact with liquid toluene, or employees who work where toluene presents a fire or explosion hazard shall annually:

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

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

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

(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 toluene above the action level, without regard to the use of respirators, or employees who may have repeated or prolonged skin contact or who may have eye contact with liquid toluene, a preplacement medical examination which must include the following:

(i) A medical history and physical examination with emphasis on the central nervous system, liver, kidneys and skin;

(ii) Urinalysis to include specific gravity, albumin, glucose and a microscopic on centrifuged sediment.

(3) Periodic medical examination. The employer shall make available to each employee exposed to airborne concentrations of toluene above the action level, without regard to the use of respirators, or employees who may have repeated or prolonged skin contact or who may have eye contact

with liquid toluene, twelve months from the date of the employee's first exposure, and every twelve months thereafter, a periodic medical examination which must include the following:

(i) A medical history and physical examination with emphasis on the central nervous system, liver, kidneys and skin;

(ii) Urinalysis to include specific gravity, albumin, glucose and a microscopic on centrifuged sediment.

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

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

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

(5) Interim medical examination. The employer shall provide an interim medical examination for the employee if the employee informs the employer of any of the signs or symptoms of exposure to toluene which are listed in Appendix A which the employee suspects are caused by exposure to toluene.

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

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

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

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

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

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

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

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

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

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to toluene;

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

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

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

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

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

(i) A recording of the results of the urinalysis;

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

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

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

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

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

(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 toluene.

(ii) This record shall include:

(A) The date of measurement;

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

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

(D) Number, duration, and results of samples taken; and

(E) Name, social security number and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

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

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken;

(C) Result of measurement.

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

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

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained;

(C) Content or scope of training provided.

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

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

(ii) This record shall include:

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

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

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

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

(E) Physician's written opinion; and

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

(iii) This record shall be maintained for the duration of and for five years after termination of the employment of the affected employee.

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

(ii) Each employee or former employee shall have access to the exposure determination and exposure measurement records required to be maintained by this section which indicate his own exposure to toluene.

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

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

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

(iii) Record the results obtained.

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

APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR TOLUENE (Toluol)

I. SUBSTANCE IDENTIFICATION

A. Substance: Toluene

B. Permissible Exposure: 200 parts of toluene per million parts of air (ppm) averaged over an eight-hour work shift. Also 300 ppm shall not be exceeded during an eight-hour work shift, except that a peak of 500 ppm of toluene is permitted for 10 minutes during the eight-hour shift.

C. Appearance and Odor: Colorless liquid with an aromatic odor, like benzene

II. HEALTH HAZARD DATA

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

B. Effects of Overexposure:

1. Short-term Exposure: Toluene may cause irritation of the eyes, respiratory tract and the skin. It may also cause fatigue, weakness, confusion, headache, dizziness, and drowsiness. Peculiar skin sensations may be produced such as a "pins and needles feeling" or numbness. Very high concentrations may cause unconsciousness and death. The liquid splashed in the eye may cause irritation and temporary damage. feeling of exhilaration, nausea and mental confusion. Inhalation may also cause difficulty in seeing in bright light. If liquid toluene is splashed in the eye, it will cause temporary irritation.

2. Long-term Exposure: Repeated or prolonged exposure to liquid toluene may cause drying and cracking of the skin.

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 toluene.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If liquid toluene gets into your eyes, occasionally. lifting the lower and upper lids occasionally.

If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If liquid toluene gets on your skin, promptly wash the contaminated skin using soap or mild detergent and water. If liquid toluene soaks through your clothing, immediately remove the clothing immediately and wash the skin using soap or mild detergent and water. If irritation is present after washing, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of toluene 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 toluene has been swallowed, get medical attention immediately. Do not attempt to make the exposed person vomit.

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 toluene. 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 toluene while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: You must wear appropriate protective clothing and equipment to prevent repeated or prolonged skin contact with liquid toluene. Replace or repair impervious clothing that has developed leaks.

C. Eye Protection: You must wear splash-proof safety goggles where liquid toluene may contact your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

A. Toluene is a flammable liquid. Its vapors can easily form explosive mixtures with air.

B. Toluene must be stored in tightly closed containers in a cool, well ventilated area away from strong oxidizers.

C. Sources of ignition such as smoking and open flames are prohibited wherever toluene is handled, used or stored in a manner that could create a potential fire or explosion hazard.

D. Metal containers in operations involving the transfer of five gallons or more of toluene should be grounded and bonded.

E. Clothing wet with liquid toluene can be easily ignited. You must immediately remove this clothing and it must not be reworn until the toluene is removed from the clothing.

F. If your skin becomes wet with liquid toluene, you must promptly wash or shower with soap or mild detergent and water to remove any toluene from your skin.

G. If you handle toluene, you must wash your hands thoroughly with soap or mild detergent and water before eating or smoking.

H. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them.

I. Ask your supervisor where toluene is used in your work area and for any additional safety and health rules.

VI. ACCESS TO INFORMATION

A. Each year your employer is required to inform you of the information contained in this Substance Safety Data Sheet for toluene. In addition, your employer must instruct you in the safe use of toluene, emergency procedures, and the correct use of protective equipment.

B. Your employer is required to determine whether you are being exposed to toluene. You or your representative have the right to observe employee exposure measurements and to record the results obtained. If your employer determines that you are being overexposed, he is required to inform you of the exposure and the actions which are being taken to reduce your exposure.

C. Your employer is required to keep records of your exposure and medical examinations. Your employer is required to keep exposure data for at least one year and to keep medical data during your employment, and for a period of five years following your termination of employment. Your employer is required to make the exposure data available to you upon your request. Your employer is also required to release your medical records to your physician upon your written request.

D. Your employer must give you a copy of the physicians written opinion for any physical examination required by this standard.

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

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APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
FOR TOLUENE (Toluol)

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Toluol; phenylmethane; methylbenzene
2. Formula: $C_6H_5CH_3$
3. Molecular weight: 92.1

B. Physical Data

1. Boiling point (760 mm Hg): 110.6 C (231 F)
2. Specific gravity (water = 1): 0.86
3. Vapor density (air = 1 at boiling point of toluene): 3.14
4. Melting point: -95 C (-139 F)
5. Vapor pressure at 20 C (68 F): 22 mm Hg
6. Solubility in water, grams of toluene per 100 grams of water (68 F): 0.05
7. Evaporation rate (butyl acetate = 1): 2.24
8. Appearance and odor: Colorless liquid with an aromatic odor, like benzene

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 4.4 C (40 F) (closed cup)
2. Autoignition temperature; 480 C (896 F)
3. Flammable limits in air, % by volume: Lower: 1.27; Upper: 7.1
4. Extinguishing media: Carbon dioxide, dry chemical, foam
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: Toluene is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where toluene is used, handled or stored in a manner that could create a potential fire or explosion hazard. Toluene vapors are heavier than air and may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which toluene is handled.
7. For purposes of conforming with the requirements of 29 CFR 1910.106, toluene is classified as a Class IB flammable liquid. For example, 3200 ppm, approximately one-fourth of the lower flammable limit, is one situation in which toluene 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 toluene shall be Class I, Group D.

B. Reactivity

1. Conditions contributing to instability: Containers may burst at elevated temperatures.
2. Incompatibilites: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon dioxide and carbon monoxide) may be released in a fire involving toluene.
4. Special precautions: Toluene will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

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

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for vapors to completely clear hood ductwork, then burn the paper. Large quantities can be reclaimed or collected and atomized in a suitable combustion chamber. Toluene must not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive concentrations of toluene are permitted.

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

C. Waste disposal methods: Toluene may be disposed of by atomizing in a suitable combustion chamber.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. EXPOSURE ABOVE THE ACTION LEVEL:

1. Eight-Hour Exposure Evaluation: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the eight-hour exposure may be determined from a single eight-hour sample or two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).
2. Ceiling Evaluation: Measurements taken for the purpose of determining employee exposure under this section must be taken during periods of maximum expected airborne concentrations of toluene in the employee's breathing zone. A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.
3. Peak Above Ceiling Evaluation: Measurements taken for the purpose of determining employee exposure under this

section must be taken during periods of maximum expected airborne concentration of toluene. Each measurement should consist of a ten minute sample or series of consective samples totaling ten minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

4. Monitoring Techniques: The sampling and analysis under this section may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The method of measurement must determine the concentration of toluene 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. When sampling for peak or ceiling exposure evaluations, more than three (3) measurements should be taken during the work shift so that increased confidence may be placed in the judgement that the employee has or has not, in fact, been exposed in excess of the permissible limit. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association. The method of measurement must determine the concentration of toluene 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 V " (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 toluene in tightly closed containers in a cool, well ventilated area.

B. High exposures to toluene can occur when transferring the liquid from one container to another.

C. Metal containers in operations involving the transfer of five gallons or more of toluene should be grounded and bonded.

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

VI. COMMON OPERATIONS

Common operations in which exposure to toluene is likely to occur are: During its production and its use as a solvent; in aviation gasoline; as an intermediate in the manufacture of benzoic acid,

dyes, explosives, and other organic chemicals; as a paint thinner; during the use of adhesives; and as a solvent in the drug, chemical, rubber and plastic industries.

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

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. TOXICOLOGY

Toluene vapor causes narcosis. Controlled exposure of human subjects to 200 ppm for 8 hours produced mild fatigue, weakness, confusion, lacrimation, and paresthesia of the skin; at 600 ppm for 8 hours there was also euphoria, headache, dizziness, dilated pupils and nausea; at 800 ppm for 8 hours, symptoms were more pronounced, and after-effects included nervousness, muscular fatigue, and insomnia persisting for several days. Severe but reversible liver and kidney injury occurred in a person who was a glue-sniffer for 3 years; the chief component of the inhaled solvent was toluene (80 percent V/V); other ingredients were not listed. In workers exposed for many years to concentrations in the range of 80 to 300 ppm, there was no clinical or laboratory evidence of altered liver function. Toluene exposure does not result in the hematopoietic effects caused by benzene; the myelotoxic effects previously attributed to toluene are judged by more recent investigations to be the result of concurrent exposure to benzene present as a contaminant in the commercial toluene used. Most of the toluene absorbed from inhalation is metabolized to benzoic acid, conjugated with glycine in the liver to form hippuric acid, and excreted in the urine; the average amount of hippuric acid excreted in the urine by individuals not exposed to toluene is approximately 0.7 to 1.0 g/liter of urine. The liquid splashed in the eyes of 2 workers caused transient corneal damage and conjunctival irritation; complete recovery occurred within 48 hours. Repeated or prolonged skin contact with liquid toluene has a defatting action, causing drying, fissuring, and dermatitis.

III. SIGNS AND SYMPTOMS

Fatigue, weakness; confusion, euphoria, dizziness, headache; dilated pupils, lacrimation; nervousness, muscular fatigue, insomnia; paresthesias of the skin and dermatitis.

IV. SPECIAL TESTS

Analysis of the urine for hippuric acid, a metabolite of toluene, is useful in monitoring exposure. A level of 5 g/liter of urine correlates to a time-weighted average of 200 ppm of toluene vapor and represents an unacceptable absorption of toluene posing a possible risk of toluene intoxication.

V. TREATMENT

Remove from exposure. Flush eyes with water and wash skin with soap or mild detergent and water. Give artificial resuscitation and administer oxygen if indicated.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of toluene are caused by its capability to produce narcosis. The after-effects from exposures to high concentrations, such as nervousness, muscular fatigue, and insomnia may last for several days. Skin absorption is known to occur. It is important that the physician become familiar with plant operating conditions in which exposure to toluene 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 toluene:

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 central nervous system, liver and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

2. Urinalysis -- Since proper kidney function is necessary for biologic monitoring, a urinalysis shall be obtained to include at a minimum specific gravity, albumin, glucose and a microscopic on centrifuged sediment. The urine shall be analyzed for hippuric acid to obtain a background level.

C. PERIODIC EXAMINATIONS

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

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Toluene," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, pp. 348-349.

2. Hygienic Guide Series: "Toluene (Toluol, Methyl Benzene)," American Industrial Hygiene Association Quarterly, 18:176-177, 1957.

3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1226-1229.

4. Occupational Exposure to Toluene, Federal Register, 40:46206-46219, October 6, 1975.

5. National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare: Criteria for a Recommended Standard....Occupational Exposure to Toluene, HSM 73-11023, U.S. Government Printing Office, Washington, D.C., 1973.

REFERENCES AND SOURCES
TOLUENE
1910.1000

(d) Compliance - Open surface tank classification based on relative evaporation rate of 3.3 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. 20.

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

COMMENTS

Eye: Grant, "Toxicology of the Eye;" International Labour Office, "Encyclopedia of Occupational Safety and Health;" Union Carbide Corp., "Toxicology Studies"

Skin: AIHA, "Hygienic Guide Series;" Union Carbide Corp., "Toxicology Studies;" Dow Chemical Co., MSDS; ANSI, "American National Standard Acceptable Concentrations"

Ingestion: Union Carbide Corp., "Toxicology Studies;" Sax, "Dangerous Properties of Industrial Materials;" Christensen, "NIOSH Toxic Substances List;" API, "API Toxicological Reviews"

COMMENTS

Eye - Classification: 2
Output statement numbers: 10
Exceptions: None

Grant reports, "liquid toluene tested by drop application to rabbit eyes has been reported by one experimenter to cause slight transient conjunctival irritation with no corneal damage detectable by fluorescein staining, but another experimenter has reported moderate injury. Difference in duration of contact may explain the variation. Injury of human eyes from liquid toluene has so far not been serious. Two patients accidentally splashed . . . are reported to have suffered transient disturbance of the eyes, with healing complete within 48 hours. Another patient . . . experienced only transient epithelial injury . . . although no irrigation was carried out for 4 or 5 minutes. . ."

The ILO reports that eye contact may cause corneal burning if the liquid is not washed away promptly with copious quantities of water.

Union Carbide reports that "a one percent solution was the least concentration causing detectable injury in the rabbit eye. This chemical is a serious eye injurant."

Grant's comments indicate that toluene has not been shown to cause permanent eye damage to humans. It is, therefore, concluded that a classification of 2 is most appropriate.

Skin - Classification: 2
Output statement numbers: 2, 7b, 16i, 21
Exceptions: See below

The Hygienic Guide Series reports that "dermatitis may result from repeated skin contact." Union Carbide reports "the undiluted chemical caused no reaction on the tender skin

of the rabbit belly greater than a faint redness of short duration." ANSI reports "defatting of the skin, followed by dermatitis, may occur on repeated contact with the liquid."

The Dow Chemical Co. MSDS reports that skin absorption is "not a problem because of low degree of toxicity." Union Carbide gives a rabbit skin penetration LD50 of 14.14 ml/kg. ANSI agrees that skin absorption is not a problem.

Toluene has a boiling point of 231 degrees F and a melting point of -139 degrees F. Its vapor pressure at 20 degrees C is 22 mm Hg and it is 0.05% soluble in water. The flash point of toluene is 40 degrees F.

A classification of 2 is concluded to be fully adequate for toluene. Indeed, the hazards of skin contact are such that statements 16g and 16i are considered to be acceptable in place of statements 17g and 17i, and specification of statement 20a is deemed to be unnecessary. Reports by Gerarde, Piotrouiski, and DutRiewiez cited in the NIOSH criteria document for Toulene indicates that skin absorption should be considered in an evaluation of exposure to toluene.

Ingestion - Classification: 2
Output statement numbers: 20b
Exceptions: None

Union Carbide gives a single oral dose rat LD50 of 7.53 gm/kg. Sax rates the acute and chronic systemic effects of ingestion to be of moderate toxic hazard. Christensen lists an oral rat LD50 of 3000 mg/kg.

The API reports "toluene has an acute narcotic effect similar to that of benzene, but lacks the convulsant neurotoxic effect of the latter . . . The chronic and cumulative effects produced by toluene are less severe and dangerous than those resulting from benzene. Toluene does not cause the severe bone marrow depression noted in benzene poisoning. Toluene in repeated doses brings about a diminution in antibody production in experimental animals, and may alter susceptibility to acute or chronic infections."

A classification of 2 is concluded to be most appropriate for this compound.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

Manufacturing Chemists' Association, Chemical Safety Data Sheet SD-63 (MCA)
National Fire Protection Association, "Fire Protection Guide on Hazardous Materials," 5th edition, 1975 (NFPA)
Union Carbide Corp., Material Safety Data Sheet (UCC)

Sources of data items used:

I. A. 1. Synonyms: MCA, NFPA-325M
2. Formula: MCA
3. Molecular weight: UCC

B. 1. Boiling point: MCA, UCC
2. Specific gravity: MCA, UCC
3. Vapor density: MCA
4. Melting point: MCA
5. Vapor pressure: UCC

6. Solubility in water: UCC
7. Evaporation rate: UCC
8. Appearance and odor: MCA, NFPA-49

II. A. 1. Flash point: MCA, NFPA-325M
2. Autoignition temperature: NFPA-325M
3. Flammable limits: MCA, NFPA-325M
4. Extinguishing media: MCA
5. Special fire fighting procedures: MCA, NFPA-325M, NFPA-49
6. Unusual fire and explosion hazards: MCA, NFPA-49

B. 1. Conditions contributing to instability: ADL
2. Incompatibilities: NFPA-491M
3. Hazardous decomposition products: None
4. Special precautions: ADL

III. A. Steps if released or spilled: MCA, UCC, ADL

C. Waste disposal methods: UCC

V. Miscellaneous precautions: MCA, ADL

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

American Petroleum Institute Toxicological Review, "Toluene," second edition, New York, 1960 (API)

Browning, Ethel, "Toxicity and Metabolism of Industrial Solvents," Elsevier Publishing Company, New York, 1965 (Browning)

Gerarde, Horace W., "Toxicological Studies on Hydrocarbons - III - The Biochemorphology of the Phenylakanes and Phenylkenes," A.M.A. Archives of Industrial Health, vol. 19, April 1959 (Gerarde)

Hay, E. B., III, "Exposure to Aromatic Hydrocarbons in a Coke Oven By - Product Plant," American Industrial Hygiene Association Journal, vol. 25, 1964 (Hay)

Hygienic Guide Series, "Toluene," American Industrial Hygiene Association, Detroit, 1964 (Hygienic Guide)

International Labour Office, "Encyclopedia of Occupational Health and Safety," McGraw-Hill Book Company, New York, 1971 (ILO)

Kanter, C. V., Elliott, J. H., Spencer, E. F., Jr., Kayne, N. and Leduc, M. F., "Control of Organic Emissions from Surface Coating Operations," Journal of the Air Pollution Association, vol. 10, no. 1, 1960 (Kanter)

Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience Publishers, Division of John Wiley, first edition, 1954 (K-O)

Manufacturing Chemists' Association, "Toluene," Manual Sheet SD-63, Chemical Safety Data Sheets, Washington, D.C. (MCA)

"Occupational Exposure to Toluene," Federal Register, Dept. of Labor, OSHA, part III, October 1975 (Federal Register)

Patty, Frank, "Industrial Hygiene and Toxicology," vol. 2, second revised edition, Interscience Publishers, New York, 1963 (Patty)

Spector, W. S. (vol. I, II), Negherbon, W. A. (vol. III), Grebe, R. M. (vol. IV) and Dittmer, D. S. (vol. V), "Handbook of Toxicology," Saunders, Philadelphia, 1956 - 1959 (Spector)

Speicher, H. W., "Solvents: Their Dangers and How to Control Them," Safety Maintenance and Production, vol. 108, no. 3, 1954 (Speicher)

"Toluene," Chemical Data Sheet No. 26, Mass. Dept. of Labor and Industries, Div. of Occupational Hygiene, February 1974 (MA)

"Toluene," Hygienic Information Guide No. 10, Comm. of Pennsylvania, Dept.

of Environmental Resources, Bureau of Occupational Health, August 1972 (PA)

Wilson, R. H., Hough, G. V. and McCormick, W. E., "Medical Problems Encountered in the Manufacture of American-Made Rubber," Industrial Medicine, vol. 17, no. 6, 1948 (Wilson)

References for Specific Use/Exposure

1. Browning, Federal Register, PA, MA, Gerarde, Hygienic Guide, Spector, Patty, K-O, ILO, Wilson
2. Browning, Patty, K-O, ILO, Hay
3. API
4. Browning, Federal Register, PA, Gerarde, Patty, ILO, Hygienic Guide
5. Browning, Hygienic Guide, ILO, Kanter
6. Federal Register, Browning, Gerarde, Patty, K-O, ILO

References for Specific Control Methods

1. ILO, K-O, Speicher
2. ILO, K-O, Speicher
3. API

ILO, K-O and Speicher were the references used in numbers 4 - 6.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Toluene

D. O. L. STANDARD: 200 ppm, where 300 ppm is the acceptable ceiling concentration, except that a peak of 500 ppm is permitted for 10 minutes during an 8-hour work shift.

WARNING PROPERTIES:

Odor Threshold: The American National Standards Institute (ANSI) states that "the odor of toluene is detectable by most people at concentrations in the range of 10 - 15 ppm. The odor has little value as a warning property."

Patty points out that olfactory fatigue occurs rapidly upon exposure to toluene.

Eye Irritation Level: Grant states that "the vapors of toluene cause noticeable sensation of irritation to human eyes at 300 to 400 ppm in air, but even at 800 ppm irritation is slight."

ANSI reports that "irritation of eyes, mucous membranes, and upper respiratory tract may occur while workers are exposed to low concentrations of toluene. There is a considerable range of variation (100 - 500 ppm) between individuals, some finding any concentration of toluene objectionable. Commercial grades of toluene vary in irritant properties."

For the purposes of this standard, half-facepiece respirators ar permitted up to a concentration of 500 ppm unless eye irritation occurs. eye irritaion occurs, a full facepiece respirator must be worn.

Evaluation of Warning Properties: Because of its irritant effects, toluene is judged to have good warning properties. Gas sorbent respiratory equipment is permitted.

IDLH: 2000 ppm

Basis for IDLH Value: The chosen IDLH seems reasonable, since Patty notes that "with 600 ppm, extreme fatigue, mental confusion, exhilaration, nausea, headache, and dizziness resulted by the end of 3 hours," and since ANSI reports that exposures to concentrations greater or longer than 4000 ppm for 5 minutes might "limit self-rescue ability."

Other Toxicological Information: According to ANSI, "with acute exposure,

toluene acts predominantly upon the central nervous system as a depressant causing fatigue, headache, confusion, paresthesia, dizziness, and muscular incoordination. There is usually some delay in the development of symptoms, and hence the effects commonly appear at the end of the work shift. Brief peak concentrations in excess of maximum acceptable concentrations may produce transient irritation. Skin absorption is not important in ordinary industrial handling of toluene, but defatting of the skin, followed by dermatitis, may occur on repeated contact with the liquid.

"An exposure to 4000 parts per million (ppm) of toluene for 5 minutes or less will probably allow self rescue with no irreversible injury. At higher concentrations or longer exposures eye irritation and beginning anesthesia are likely to limit self-rescue ability. This information is based on extrapolation from animal experiments and human experience."

Patty states that "toluene is a more powerful narcotic and is more toxic acutely than benzene. Smyth and Smyth found animals severely affected, but no deaths resulted after 18 daily 4-hour exposures to 1250 ppm toluene, whereas a few daily 4-hour exposures to 4000 ppm caused fatalities in the exposed animals. . .

"Controlled exposures of human beings to concentrations of 50 to 800 ppm indicate that exposure to a concentration of 200 ppm for a period of 8 hours produces mild fatigue, weakness, confusion and paresthesis of the skin. The fatigue persisted for hours and moderate insomnia and restlessness resulted. The same symptoms were more pronounced with 300 ppm. With 400 ppm mental confusion was added to the list of symptoms. With 600 ppm extreme fatigue, mental confusion was added to the list of symptoms. With 600 ppm extreme fatigue, mental confusion, exhilaration, nausea, headache, and dizziness resulted by the end of 3 hours. After 8 hours, the mental confusion, weakness, dizziness, and nausea were pronounced. The pupils were dilated and accommodation to light was impaired. The subjects lost coordination and had a staggering gait. These effects persisted for hours and the subjects complained of insomnia. Fatigue and nervousness were still present on the second day. With 800 ppm the same symptoms were more pronounced and after effects, characterized by severe nervousness, muscular fatigue, and insomnia, lasted for several days. Exposures to 50 and 100 ppm failed to present distinct symptoms or after effects."

The Documentation of TLV's states that "Wilson found that among workers exposed at less than 200 ppm of toluene there were some complaints of headache, lassitude and nausea, but physical findings were essentially negative. At concentrations between 200 and 500 ppm impairment of coordination, momentary loss of memory and anorexia were also observed, but no significant physical or laboratory findings were present. Between 500 and 1500 ppm palpitation, extreme weakness, pronounced loss of coordination and impairment of reaction time were noted. The red cell count fell in many instances, and there were two cases of aplastic anemia, in which recovery followed intensive hospital treatment. A later comment by Wilson, however, suggests that he did not rule out the possibility that some of the above effects were due to a benzene impurity in the toluene used. . .

". . . recent industrial experience fails to provide evidence for a TLV below 200 ppm, in the basis of irritative or narcotic effects observed in workers exposed at or near this concentration."

LFL: 12,700 ppm
VAPOR PRESSURE AT 20 C: 22 mm Hg
SATURATED CONCENTRATION AT 20 C: Approximately 28,900 ppm

USE/EXPOSURE AND CONTROL DOCUMENT
TOLUENE

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor and skin contact with liquid or vapor during use/application as a solvent in drug, chemical, rubber and plastic industries (gums; fats; resins; thinner for paints, varnishes, lacquers and enamals; as paint remover; coatings; neoprene; inks; dyes, plastics; insecticides; coal-tar; asphalt; pitch; acetyl-celluloses)	A,B,D	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment (goggles, gloves, protective clothing, respiratory protective devices); good personal hygiene practice
2.	Inhalation of vapor and skin contact with liquid or vapor during production/manufacture (as a by-product from the gases and coal-tar metallurgical coke-oven industry; or as a by - product of the petrochemical industry by dehydrogenation of cycloparaffin fractions; or by aromatization of saturated aliphatic hydrocarbons)	A,B,D	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment (goggles, gloves, protective clothing, respiratory protective devices); good personal hygiene practice
3.	Inhalation of vapor and skin contact with liquid during use in cleaning operations (tank cars, vats, storage tanks)	A,B,D	Local exhaust ventilation; personal protective equipment (goggles, gloves, protective clothing, respiratory protective devices); good personal hygiene practice
4.	Inhalation of vapor and skin contact with liquid or vapor during use as a starting material in the chemical industry in the manufacture of organic chemicals and as an intermediate in	A,B,D	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment (goggles, gloves, protective clothing, respiratory protective devices); good personal hygiene practice

	chemical synthesis (plastics, paints, pesticides, protective coatings, resins, drugs, explosives and dyes)		
5.	Inhalation of vapor and skin contact with liquid or vapor during use in the manufacture of artificial leather; fabric and paper coatings; as a diluent (cellulose ester lacquers); photogravure inks; spray surface coatings	A,B,D	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment (goggles, gloves, protective clothing, respiratory protective devices); good personal hygiene practice
6.	Inhalation of vapor and skin contact with liquid or vapor during use/formulation as a constituent of automotive and aviation fuels	A,B,D	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment (goggles, gloves, protective clothing, respiratory protective devices); good personal hygiene practice

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

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

1,408 CARDS READ

0 SYSOUT PRINT RECORDS

0 SYSOUT PUNCH RECORDS

0.00 MINUTES EXECUTION TIME

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