NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND SUPPORTING DOCUMENTATION FOR

*** TURPENTINE ***

NIOSH/OSHA Draft Technical Standard and Supporting Documentation for TURPENTINE

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 TURPENTINE.

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.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for TURPENTINE

(a) DEFINITIONS

(1) PERMISSIBLE EXPOSURE - "Permissible Exposure" means inhalation of turpentine in concentrations not in excess of 100 parts per million (ppm) (560 milligrams per cubic meter, mg/cu.m.) averaged over an eight hour work shift, as stated in section 1910.93, Table G-1.

(2) ACTION LEVEL - "Action Level" means one half (1/2) of the permissible exposure for turpentine.

(3) Turpentine: Means spirits or oil of turpentine; boiling range 150-180C (302-356F); minimum alpha-pinene content 40 percent by weight;
Boiling Range: ASTM D13-65
Alpha Pinene: Kirk Othmer Encycl. Chem. Tech. Vol.20, 2nd Ed. 1969.

(b) EMPLOYEE INFORMATION - Each employer who has a workplace in which turpentine is present shall:

(1) STANDARD AVAILABILITY - Keep a copy of this section with its appendices A, B and C, at the workplace. This material shall be made readily available to affected employees; and

(2) PRESENCE OF STODDARD SOLVENT - Inform affected employees of the quantity, location, and manner of use or storage of turpentine.

(c) EXPOSURE MEASUREMENT

(1) INITIAL DETERMINATION - Each employer who has a place of employment in which turpentine is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of turpentine 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 turpentine. A written determination shall be made and it shall contain at least the following information:

(i) Any information, observations, or calculations which would indicate employee exposure to turpentine;

(ii) Any measurements of airborne concentrations of turpentine taken;

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

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

(2) INITIAL EXPOSURE MEASUREMENT - If the employer determines that any employee may be exposed to airborne concentrations of turpentine at or above the action level, the exposure of the employee believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum exposure of the employee.

(3) IDENTIFICATION OF EXPOSED EMPLOYEES - If the exposure measurement taken under paragraph (c)(2) of this section reveals employee exposure to airborne concentrations of turpentine 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.

(4) EXPOSURE ABOVE THE ACTION LEVEL - If an employee exposure measurement reveals that an employee is exposed to airborne concentrations of turpentine 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.

(5) EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE - If an employee exposure measurement reveals that an employee is exposed to airborne concentrations of turpentine above the permissible exposure, the employer shall:

(i) Inform the employee of the exposure as required by paragraph (N)(1) of this section; and

(ii) Measure the exposure of the employee at least monthly; and

(iii) Institute control measures as required by paragraph (E) of this section.

(6) TERMINATION OF EXPOSURE MEASUREMENT - If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to airborne concentrations of turpentine below the action level, the employer may terminate measurement for the employee. For purposes of this subparagraph, use of respirators shall not constitute reduction of employee exposure below the action level.

(d) METHODS OF MEASUREMENT - 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 (Appendix B (iv)). The method of measurement shall have an accuracy, to a confidence level of 95%, of not less than that given in Table 1 below.

Table 1

Concentration	Required Accuracy
Above permissible exposure	Plus or Minus 25%
At or below permissible exposure and above the action level	Plus or Minus 35%
At or below the action level	Plus or Minus 50%

(e) Methods of Compliance

(1) Engineering controls - No employee shall be exposed to turpentine above the permissible limit as defined in paragraph (a)(1) of this section. Engineering and work practice controls shall be used to reduce exposure to turpentine to at or below the permissible exposure.

(i) When mechanical ventilation is used to control exposure, measurements which demonstrate system efficiency (for example: air velocity, static pressure, or air volume) shall be made at least every three months. Measurements of system efficiency shall also be made within five work days of any change in production, process or control which might result in a reduction in control.

(ii) Where a fan is located in duct work and where turpentine is present in concentrations greater than 2000 ppm, one fourth of the lower flammable limit, the fan rotating element shall consist of, or be lined with, non-sparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(iii) In the design of open surface tank ventilation for the purposes of section 1910.94 (d), operations involving turpentine shall be classified as B-3 at 70 F.

(2) Respirators

(i) Compliance with the permissible exposure may not be achieved by the use of respirators except:
   a. During the time period necessary to install engineering controls; or
   b. In work situations in which engineering controls are technically not feasible; or
   c. In work situations in which feasible engineering and work practice controls are insufficient to reduce employees exposure to at or below the permissible exposure. Where technically feasible engineering and work practice controls are not sufficient to reduce exposure to at or below permissible exposure, they shall be used to reduce exposure to the lowest level feasible; or
   d. For operations not exceeding 40 hours per year; or
   e. In emergencies.

(ii) Respirators shall be jointly approved by the mining enforcement and safety administration (formerly Bureau of Mines) and by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(iii) Employers shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

(iv) Employers shall institute a respiratory protection program in accordance with sections 1910.134(b), (d), (e), and (f).

TABLE 2. RESPIRATORY PROTECTION FOR TURPENTINE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Vapor Concentration	
Equal to or less than 1000 ppm	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 full facepiece.
Greater than 1500 ppm or escape and entry 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 m

	and an auxiliary self-contained breath 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.

(f) Fire and Safety

Employers shall familiarize themselves with the information contained in the Substance Technical Guidelines for turpentine which is contained in Appendix B in order to ensure the safe handling and use of turpentine.

(1) Electrical - For the purposes of compliance with section 1910.309, locations classified as hazardous locations due to the presence of turpentine shall be Class I Group D.

(2) Portable fire extinguishers - For the purposes of compliance with section 1910.157, turpentine is classified as a Class B fire hazard.

(3) Powered industrial trucks - For the purposes of compliance with section 1910.178, locations classified as hazardous locations due to the presence of turpentine shall be Class I Group D.

(4) Flammable liquids - For the purposes of compliance with section 1910.106, liquid turpentine is classified as a Class IC flammable liquid. Spray finishing operations shall be performed in accordance with sections 1910.107 and 1910.94 (c). Dip tank operations shall be performed in accordance with sections 1910.108 and 1910.94 (d).

(5) Sources of ignition - Sources of ignition such as smoking or open flames are prohibited where turpentine is handled, used or stored in a manner so as to create a potential fire or explosion hazard.

(6) Storage - Turpentine shall be stored so as not to come in contact with chlorine and strong oxidizers. Turpentine, being subject to spontaneous heating, shall be stored in a cool, well-ventilated area.

(g) Personal Protective Equipment

(1) Skin Contact

(i) Employers shall provide, and require employees to use, impervious clothing, gloves, face shields (8-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact to liquid turpentine. Face shields shall comply with section 1910.133(a)(6).

(ii) Employers shall ensure that clothing wet with liquid turpentine is placed in closed containers. Employers shall provide for the cleaning or disposal of such clothing and if the clothing is to be laundered or otherwise cleaned, shall

inform the person performing this operation of the hazardous properties of turpentine.

(iii) Employers shall ensure that non-impervious clothing contaminated with liquid turpentine be removed promptly and not reworn until the turpentine is removed from the clothing.

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

(2) Eye Contact

(i) Employers shall provide, and require employees to use, splash-proof safety goggles (cup-cover type dust and splash safety goggles), which comply with section 1910.133 (a)(6), where eye contact to liquid turpentine may occur.

(h) Spills

(1) Spills of turpentine shall be cleaned up immediately after eliminating potential sources of ignition and utilizing available ventilation.

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

(i) Sanitation

(1) Employers shall ensure that employees whose skin becomes contaminated with liquid turpentine promptly wash or shower using soap or mild detergent to remove any turpentine from the skin.

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

(j) Training and Information - Each employer who has employees exposed to turpentine in excess of the action level, or employees who may have skin or eye contact with liquid turpentine, or employees who work where accidental release, spill, fire, or explosion of turpentine may occur, shall annually:

(1) Substance Safety Data Sheet - Inform each employee of the information contained in the Substance Safety Data Sheet for turpentine, which is contained in Appendix A; and

(2) Medical -

(I) Advise employees as to the signs and symptoms of exposure to turpentine.

(II) Instruct the employees to advise the employer of the development of signs and symptoms of exposure to turpentine which are listed in Appendix A.

(III) Instruct the employees to inform the employer if they develop any of the medical conditions listed in (k)(2) of this section; and

(3) Procedures -

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

(II) The procedures required by (j)(1), (2), and (3)(I) shall be provided to employees at the expense of the employer during the employee's normal working hours.

(k) Medical Surveillance

(1) The employer shall provide medical procedures as required by paragraph (k). These procedures shall be provided at no cost to the employee.

(2) Preplacement Questionnaire - The employer shall obtain from each employee who will be exposed to liquid turpentine, or airborne concentrations of turpentine at or above the action level, a written statement as to whether such employee has a history of any of the following:
   (i) Skin disease
   (ii) Liver disease
   (iii) Kidney disease
   (iv) Chronic lung disease

(3) Preplacement Medical Examination - The employer shall provide a medical examination for an employee if the employee provides a history of any of the conditions named in paragraph (k)(2).

(4) Results of Preplacement Examination - The employer shall obtain a physician's written opinion based on the medical examination pursuant to paragraph (k)(3).

(5) Periodic Medical Examinations - The employer shall provide a medical examination for an employee if the employee advises the employer of the development of:
   (i) Any of the medical conditions listed in (k)(2).
   (ii) Signs and symptoms listed in Appendix A which the employee suspects may be caused by exposure to turpentine.

(6) Results of Periodic Examinations - The employer shall obtain a physician's written opinion based on the medical examination pursuant to paragraph (k)(5).

(7) Exclusion or Removal from Exposure - No employee shall continue to be exposed to turpentine if such exposure could place the employee at increased risk of material impairment of his health.

(8) Emergency Procedures - The employer shall provide emergency and follow-up medical examinations and treatment for any employee injured through exposure to turpentine.

(9) Informing the Physician - The employer shall provide to the examining physician the following information:
   (i) A copy of this section with its Appendices A, B, and C;
   (ii) A description of the employee's duties as they relate to his exposure to turpentine;
   (iii) A description of any personal protective equipment, including respirators, required to be used;
   (iv) The results of any employee's exposure measurement, if available;
   (v) The employee's anticipated exposure level; and
   (vi) Upon request of the physician, information from previous medical examination of the employee.

(10) Physician's Written Opinion
   (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 conditions which could be directly or indirectly aggravated by exposure to turpentine or which could significantly interfere with the ability of the employee to follow

recommended or required procedures for protecting himself from unusual or emergency exposure.

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

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

(ii) The written opinion shall not reveal medical information unrelated to exposure to turpentine.

(11) Refusal to be Medically Examined - 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.

(l) Recordkeeping.

(1) Initial determination.

(i) The employer shall keep an accurate record of all initial determinations required to be made pursuant to paragraph (c)(1) of this section.

(ii) The record shall include the written determination and any supporting documentation as required in paragraph (c)(1) 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 turpentine.

(ii) This record shall include:

(a) The date of measurement;

(b) A reference to the subparagraph of this regulation which required the measurement, if any;

(c) Operations involving exposure to turpentine which are being monitored;

(d) Sampling and analytical methods used and evidence of their accuracy;

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

(f) 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 a record of measurements demonstrating the effectiveness of such ventilation as required by paragraph (e)(1)(i) of this section.

(ii) This record shall include:

(a) Date of measurement;

(b) Type of measurement taken;

(c) Result of measurement.

(iii) This record shall be maintained for at least one year.

(4) Training and information.

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

(ii) The record shall include:

(a) Date of training;

(b) Name and Social Security number of employees trained;

(c) Substance of training provided.

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

(5) Medical records.

(i) The employer shall keep an accurate medical record for each employee.

(ii) The record shall include:

(a) Physician's written opinion;

(b) Preplacement questionnaire;

(c) Any employee medical complaints relative to exposure to turp

(d) A signed statement of any refusal to be examined;

(e) A copy of information provided to the physician pursuant to paragraph (k)(9)(ii) through (vi) of this section.

(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 and the Director.

(ii) Employee 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.

(m) Observation of monitoring.

(1) Duty.

The employer shall give affected employees or their representatives an opportunity to observe any monitoring of employee exposure to turpentine which is conducted pursuant to this section.

(2) Exercise of opportunity to observe monitoring.

(i) When observation of the monitoring of employee exposure to turpentine requires entry into an area where the use of personal protective devices is required, the observer shall use such equipment and comply with all other applicable safety procedures.

(ii) Without interfering with the measurement, observers shall be entitled to:

(a) Receive an explanation of the measurement procedures;

(b) Visually observe all steps related to the measurement of exposure to turpentine that are being performed at the place of exposure.

(c) Record the results obtained.

(n) Employee notification.

(1) The employer shall notify in writing, within five work days, every employee who is found to be exposed to turpentine above the permissible exposure. The employee shall also be notified of the level of his exposure and the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(2) Pursuant to paragraph (k) of this Section, when an employee is medically examined the employer shall provide the employee with a copy of the physician's written opinion.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET

I. SUBSTANCE IDENTIFICATION

SUBSTANCE: Turpentine

PERMISSIBLE EXPOSURE: 100 parts of turpentine per million parts of air (ppm) or 560 milligrams of turpentine per cubic meter of air (mg/cu m)

APPEARANCE AND ODOR: Colorless liquid with a characteristic paint-like odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Turpentine may 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 also enter your body through your skin.

B. Effects of Overexposure:

1. Short-Term Overexposure: Overexposure to turpentine may cause irritation of the eyes, nose, throat, lungs, and skin. It may also cause headache, dizziness, and painful urination or dark red urine. Greater exposure may cause unconsciousness and death.

2. Long-Term Overexposure: Prolonged overexposure causes skin irritation. Skin sensitization can occur.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms associated with turpentine exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If turpentine gets into your eyes, wash the eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If turpentine gets on your skin, promptly wash the contaminated skin using soap or mild detergent. If turpentine soaks through your clothing, remove the clothing immediately and wash the skin using soap or mild detergent. If irritation persists after washing, get medical attention. Do not wear the clothing again until the turpentine is removed. Replace or repair impervious clothing that has developed leaks.

C. Breathing: If you or any other person breathes in large amounts of turpentine remove 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: If turpentine has been swallowed do not cause vomiting. 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 turpentine. You can only be required to wear them for routine use if your employer is in the process of installing controls or if 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)/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 turpentine 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 impervious clothing, gloves, face shield or other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid turpentine.

C. EYE PROTECTION: You must wear splash-proof safety goggles (cup-cover type dust and splash safety goggles) where eye contact with liquid turpentine may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

A. Turpentine is a flammable liquid and its vapor easily form explosive mixtures with air. Cloth rags or other similar combustible materials contaminated with turpentine may spontaneously ignite.

B. Turpentine must be stored in tightly closed containers in a cool, well ventilated area away from heat, sparks, flames and strong oxidizers (especially chlorine).

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

D. You must use non-sparking tools when opening or closing metal containers of turpentine, and containers must be bonded and grounded when pouring or transferring liquid turpentine.

E. If your skin becomes contaminated with liquid turpentine, you must promptly wash or shower to remove the turpentine from your skin.

F. Clothing wet with liquid turpentine can be easily ignited. You must immediately remove any clothing that becomes wet with liquid turpentine and this clothing must not be reworn until the turpentine is removed from the clothing.

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

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 turpentine is used in your work area and for any additional plant safety and health rules.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
TURPENTINE

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for TURPENTINE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Gum spirits of turpentine; turps; wood turpentine; spirits of turpentine; sulfate wood turpentine; sulfate turpentine; gum turpentine; steam distilled turpentine
2. Formula: C10H16 (Approx.); minimum alpha-pinene content 40 per cent by weight
3. Molecular weight: 136 (approx)

B. Physical Data

1. Boiling point (760 mm Hg): 150 to 180 C (302 to 356 F)
2. Specific gravity (water=1): 0.864
3. Vapor density (air=1 at boiling point of turpentine): 4.7
4. Melting point: -50 to -60 C (-58 to -76 F)
5. Vapor pressure at 25 C (77 F): 5 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): Insoluble
7. Evaporation rate (butyl acetate=1): Data not available
8. Appearance and odor: Colorless liquid with a characteristic paint odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 35 C (95 F) (closed cup)
2. Autoignition temperature: 253 C (488 F)
3. Flammable limits in air, % by volume: Lower: 0.8
4. Extinguishing media: Dry chemical, foam, carbon dioxide
5. Special fire-fighting procedures: Do not use a solid stream of water since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Turpentine is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where turpentine is handled, used or stored. Turpentine 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 turpentine is handled.
7. For purposes of conforming with the requirements of 29 CFR 1910.106, turpentine is classified as a Class IC flammable liquid. At 2000 ppm, one-fourth of the lower flammable limit, turpentine 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 turpentine shall be Class I Group D.

B. Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizing agents (especially chlorine) may cause fire and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving turpentine.

4. Special precautions: Turpentine will attack some forms of plastics, rubber and coatings

III. SPILL, LEAK AND DISPOSAL PROCEDURES

A. If turpentine 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. 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. Turpentine may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

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

C. Waste disposal methods:
Turpentine may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a sanitary landfill.
2. By atomizing in a suitable combustion chamber.

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 eight-hour exposure may be determined from a single eight-hour sample or two (2) 4-hour samples. Short term interval samples (up to 30 minutes) may also be used to determine average exposure level if a minimum of five (5) measurements are taken in a random manner over the eight-hour work shift. Random sampling means that any portion of the work shift has the same chance of being sampled as any other. The arithmetic average of all such random equal duration samples taken on one (1) work shift is an estimate of an employee's average level of exposure for that work shift. 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, gas and vapor adsorption tubes with subsequent chemical analyses or dosimeters. The method of measurement must determine the concentration of turpentine to plus or minus 35%.

b. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring 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 (AIHA). The method of measurement must determine the concentration of turpentine to plus or minus 25%. Methods meeting these accuracy requirements are available in the "NIOSH Monitoring Methods Manual".

V. MISCELLANEOUS PRECAUTIONS

A. Store turpentine in tightly closed containers in a cool, well-ventilated area.

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

C. Non-sparking tools must be used to open and close metal turpentine containers. These containers must be effectively grounded and bonded prior to pouring.

D. Cloth rags or other similar combustible materials contaminated with turpentine may spontaneously ignite.

E. Employers must advise employees of all plant areas and operations where exposure to turpentine could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to turpentine is likely to occur are: during its use as a solvent and thinner in paints, varnishes, lacquers and polishes, and during the manufacture of pine oil, flavors, perfumes, beta-pinene resins and synthetic camphor.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; possible skin absorption.

II. TOXICOLOGY

Turpentine vapor is a mucous membrane irritant, and at higher concentrations, is a convulsant. The LC50 for rats is 3,590 ppm for 1 hour and 2,150 ppm for 6 hours; hyperpnea, ataxia, tremors and convulsions were noted. In cats 1,440 ppm produced disturbances in equilibrium and convulsions in 30 to 60 minutes; paralysis in 150 to 180 minutes. In human subjects 750 to 1,000 ppm for several hours caused irritation of the eyes, headache, dizziness, nausea and tachycardia; 1,878 ppm for 1 to 4 hours was considered definitely toxic. Heavy overexposure is also reported to cause irritation of the nose and throat;

cough, headache, vertigo and irritation of the kidneys and bladder manifested by transient albuminuria and hematuria. However, there is little evidence that turpentine vapor at lower concentrations is a chronic systemic poison. Liquid in the eye causes conjunctivitis and corneal burns; a vapor concentration of 75-200 ppm is said to be moderately irritating. The liquid is also a defatting agent and causes skin irritation. Some persons may develop skin hypersensitivity. Mild intoxication from skin absorption has been reported.

III. SIGNS AND SYMPTOMS

Irritation of the eyes, nose and throat; headache and vertigo; hematuria and albuminuria; skin irritation and sensitization.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Flush eyes with water and wash skin with soap and water. Give artificial resuscitation if indicated. Recovery is usually rapid and complete. Do not induce vomiting if swallowed.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of turpentine are caused by its irritant and sensitizing properties. It is important that the physician becomes familiar with plant operating conditions in which exposure to turpentine 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

Routine medical histories and physical examination are not required. However, the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from turpentine exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Skin disease -- Turpentine is a skin defatting agent and sensitizer and can cause dermatitis especially on prolonged exposure. Persons with preexisting skin disorders may be more susceptible to the effects of this agent.

2. Liver disease -- Although turpentine is not known as a liver toxin in humans, the importance of this organ in the

biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

3. Kidney disease -- Turpentine has been reported to cause albuminuria and hematuria in humans and special consideration should be given to those with a history of impaired renal function.

4. Chronic respiratory disease -- In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of turpentine might cause exacerbation of symptoms due to its irritant properties.

C. PERIODIC EXAMINATIONS

Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

References

1. American Conference of Governmental Industrial Hygienists: "Turpentine," (3d ed., 2d printing), Documentation of the Threshold Limit Values for Substances in Workroom Air, Cincinnati, 1974, p. 274.

2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1213-1214.

3. Hygienic Guide Series: "Turpentine," American Industrial Hygiene Association Journal, 28:297-300, 1967.

REFERENCES AND SOURCES
TURPENTINE
1910.93

(d) Methods of Compliance - The relative evaporation rate for turpentine is 95% evaporated in 20 hours, 100% evaporation in much more than 50 hours. Open surface tank classification has been based on 95% evaporation time. A. K. Doolittle, "The Technology of Solvents and Plasticizers", John Wiley & Sons, Inc., New York, 1954, pp. 354-357.

(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. 21.

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

Eye: AIHA Hyg. Guides; Grant, "Toxicology of the Eye"

Skin: Sax, "Dangerous Properties of Ind. Materials"; Stolman, "Progress in Chemical Toxicology"; Patty, "Ind. Hyg. and Tox."; Gleason, "Clinical Toxicology of Commercial Products"; PHS-149, "Survey of Compounds Which Have Been Tested for Carcinogenic Activity"; and AIHA Hyg. Guide

Ingestion: Sax, "Dangerous Properties of Ind. Materials"; Stolman, "Progress in Chemical Toxicology"; Gleason, "Clinical Toxicology of Commercial Products"; and Kirk-Othmer, "Encyclopedia of Chemical Technology"

COMMENTS

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

AIHA notes that "turpentine liquid is reported to cause conjunctivitis and corneal burns." Grant, in summarizing the wor others, states that "Accidental contact of the liquid with the ey immediate severe pain and blepharospasm. This may be followed by conjunctival hyperemia and slight transient injury of the corneal epithelium. In severe cases temporary erosion of the epithelium may occur, but no damage of the corneal stroma has been noted in patients or rabbits after splash contact."

Since any injury caused is noted as being transient, the substance is assigned a classification of 2.

Skin - Classification: 2
Output statement numbers: 2, 7b, 17g and 21 combined, 20a
Exceptions: None

Sax lists it as an acute local irritant of moderate toxic ha an acute local allergen of slight toxic hazard, and a chronic loc allergen and irritant of moderate toxic hazard. By skin absorpti it is listed as having acute systemic effects of moderate toxic hazard and chronic systemic effects of slight toxic hazard. Stolman notes that skin contact in hypersensitive individuals wi result in erythema and itching. Patty notes that some individual develop a hypersensitivity after prolonged or repeated exposure. that it is readily absorbed through the skin and that renal damage has occurred from chronic skin contact. PHS-149

notes that skin tumors have developed in mice after repeated applications. AIHA notes that prolonged contact may cause dermatitis and that the possibility of skin absorption should be considered if there is prolonged contact.

Turpentine has a vapor pressure of 5 mm Hg at 20 degrees C. It is insoluble in water and has a flash point of 95 degrees F.

A classification of 2 is concluded to be appropriate to prevent the cited effects.

Ingestion - Classification: 0
Output statement numbers: None
Exceptions: None

Sax considers its acute systemic effects by ingestion to be of high toxic hazard and its chronic systemic effects to be of sligh toxic hazard. Stolman notes that accidental ingestion will induce local irritation of the entire gastroenteric tract and injury to the kidneys "if the dose is large." The probable lethal dose for adults is 150 ml. Gleason notes that many accidental poisonings through ingestion have been reported and they include several fatalities. K-O gives rat LD50's from 1.4 - 5.2 g/kg.

Since the literature does not indicate that repeated ingesti of small amounts is harmful, it is concluded that, in the context this standard, ingestion would not present a hazard in the indust environment.

SUBSTANCE TECHNICAL GUIDELINES
TURPENTINE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Gum spirits of turpentine; turps; wood turpentine; spirits of turpentine; sulfate wood turpentine; sulfate turpentine; gum turpentine; steam distilled turpentine
2. Formula: $C_{10}H_{16}$ (Approx.); minimum alpha-pinene content 40 per cent by weight
3. Molecular weight: 136 (approx)

B. Physical Data

1. Boiling point (760 mm Hg): 150 to 180 C (302 to 356 F)
2. Specific gravity (water=1): 0.864
3. Vapor density (air=1 at boiling point of turpentine): 4.7
4. Melting point: -50 to -60 C (-58 to -76 F)
5. Vapor pressure at 25 C (77 F): 5 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): Insoluble
7. Evaporation rate (butyl acetate=1): Data not available
8. Appearance and odor: Colorless liquid with a characteristic paint odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 35 C (95 F) (closed cup)
2. Autoignition temperature: 253 C (488 F)
3. Flammable limits in air, % by volume: Lower: 0.8
4. Extinguishing media: Dry chemical, foam, carbon dioxide

5. Special fire-fighting procedures: Do not use a solid stream of water since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Turpentine is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where turpentine is handled, used or stored in a manner that could create a potential fire or explosion hazard. Turpentine 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 turpentine is handled.
7. For purposes of conforming with the requirements of 29 CFR 1910.106, turpentine is classified as a Class IC flammable liquid. For example, 2000 ppm, approximately one-fourth of the lower flammable limit, is one situation in which turpentine 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 turpentine shall be Class I Group D.

B. Reactivity
1. Conditions contributing to instability: Heat.
2. Incompatibilities: Contact with strong oxidizing agents (especially chlorine) may cause fire and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving turpentine.
4. Special precautions: Turpentine will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK AND DISPOSAL PROCEDURES

A. If turpentine 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. 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. Turpentine may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

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

C. Waste disposal methods: Turpentine 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.

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 eight-hour exposure may be determined from a single eight-hour sample or two (2) 4-hour samples. Short term interval samples (up to 30 minutes) may also be used to determine average exposure level if a minimum of five (5) measurements are taken in a random manner over the eight-hour work shift. Random sampling means that any portion of the work shift has the same chance of being sampled as any other. The arithmetic average of all such random equal duration samples taken on one (1) work shift is an estimate of an employee's average level of exposure for that work shift. 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, gas and vapor adsorption tubes with subsequent chemical analyses or dosimeters. The method of measurement must determine the concentration of turpentine to plus or minus 35%.

b. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring 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 (AIHA). The method of measurement must determine the concentration of turpentine to plus or minus 25%. Methods meeting these accuracy requirements are available in the "NIOSH Monitoring Methods Manual".

V. MISCELLANEOUS PRECAUTIONS

A. Store turpentine in tightly closed containers in a cool, well-ventilated area.

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

C. Non-sparking tools must be used to open and close metal turpentine containers. These containers must be effectively grounded and bonded prior to pouring.

D. Cloth rags or other similar combustible materials contaminated with turpentine may spontaneously ignite.

E. Employers should advise employees of all plant areas and operations where exposure to turpentine could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to turpentine is likely to occur are: During its use as a solvent and thinner in paints, varnishes, lacquers and polishes, and during the manufacture of pine oil, flavors, perfumes, beta-pinene resins and synthetic camphor.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Turpentine

D. O. L. STANDARD: 100 ppm

WARNING PROPERTIES:

Odor Threshold: Patty states that "the odor of 200 ppm turpentine in air is readily noticeable."

Eye Irritation Level: Patty states that 200 ppm "is moderately irritating to eyes and mucous membranes of the nasal passages."

Evaluation of Warning Properties: Through its odor and irritant effects, turpentine can be detected at a level within two times the permissible

exposure limit. For the purposes of this standard, turpentine is treate a material with good warning properties. Gas sorbent respiratory equipm is permitted.

IDLH: 1900 ppm

Basis for IDLH Value: The chosen IDLH (1900 ppm) is based upon the report in AIHA Hygienic Guides that "a concentration of 1878 ppm for one to four h is definitely toxic to man." The Hygienic Guides report a 6-hour rat LC of 2150 ppm. An IDLH concentration for man is not given in the Hygienic Guides.

Other Toxicological Information: According to the AIHA Hygienic Guides, Sper "found the LC50 for rats to be about 3590 ppm for one hour and about 215 for six hours. He concluded that the acute effects are basically on the central nervous system as demonstrated by change in respiratory rate, at tremors and convulsions. Lung irritation was not seen." The Hygienic Guides state that "inhalation of 750 to 1000 ppm of turpentine oil for several hours caused irritation of the eyes, headache, dizziness, nausea accelaeration of the pulse. A concentration of 1878 ppm for one to four hours is definitely toxic to man. (The) atmospheric concentration immed hazardous to life (is) not known for man. Lehman reported that turpenti oil vapor at a concentration of 2880 ppm killed cats in from 45 to 60 mi He also reported that a concentration of 1440 ppm produced disturbances equilibrium and tonic convulsions in cats in 30 to 60 minutes and paraly in 150 to 1680 minutes."

Patty states that "men exposed to concentrations of 720 to 1100 p compalin of eye irritation, headache, dizziness, nausea, chest pain, and disturbances."

LFL: 8000 ppm

VAPOR PRESSURE AT 20 C: 5 mm Hg

SATURATED CONCENTRATION AT 20 C: Approximately 6580 ppm

USE/EXPOSURE AND CONTROL DOCUMENT
TURPENTINE

Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1. Inhalation of vapor and skin contact with liquid during the manufacture of synthetic pine oil	A,B	Local exhaust ventilation; process enclosure; persona protective equipment (respiratory protective de
2. Inhalation of vapor and skin contact with liquid during the manufacture of insecticides	A,B	Local exhaust ventilation; process enclosure; persona protective equipment (respiratory protective de
3. Inhalation of vapor and skin contact with liquid during the manufacture of beta-pinene resins	A,B	Local exhaust ventilation; process enclosure; persona protective equipment (respiratory protective de
4. Inhalation of vapor and skin contact with liquid during the preparation of flavors and perfumes	A,B	Local exhaust ventilation; process enclosure; persona protective equipment (respiratory protective de
5. Inhalation of vapor and skin contact with liquid during the preparation and use of polishes	A,B	Local exhaust ventilation; process enclosure; persona protective equipment (respiratory protective de
6. Inhalation of vapor and skin contact with liquid during the manufacture of synthetic camphor	A,B	Local exhaust ventilation; process enclosure; persona protective equipment (respiratory protective de
7. Inhalation of vapor and skin contact with liquid during preparation and use of paints containing turpentine (Once the largest use, now largely replaced by petroleum distillates and chlorinated hydrocarbons)	A,B	Local exhaust ventilation; process enclosure; persona protective equipment (respiratory protective devices)

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

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

1,232 CARDS READ

0 SYSOUT PRINT RECORDS

0 SYSOUT PUNCH RECORDS

0.00 MINUTES EXECUTION TIME

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