NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND

SUPPORTING DOCUMENTATION FOR

*** ISOAMYL ACETATE ***

NIOSH/OSHA Draft Technical Standard and Supporting Documentation for ISOAMYL ACETATE

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 ISOAMYL ACETATE.

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 ISOAMYL ACETATE

(a) DEFINITIONS

(1) PERMISSIBLE EXPOSURE - "Permissible Exposure" means inhalation of isoamyl acetate in concentrations not in excess of 100 parts per million (ppm) (525 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 isoamyl acetate.

(b) EMPLOYEE INFORMATION - Each employer who has a workplace in which isoamyl acetate 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 ISOAMYL ACETATE - Inform affected employees of the quantity, location, and manner of use or storage of isoamyl acetate.

(c) EXPOSURE MEASUREMENT

(1) INITIAL DETERMINATION - Each employer who has a place of employment in which isoamyl acetate is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of isoamyl acetate 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 isoamyl acetate. 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 isoamyl acetate;

(ii) Any measurements of airborne concentrations of isoamyl acetate taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to isoamyl acetate; 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 isoamyl acetate 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) INDENTIFICATION OF EXPOSED EMPLOYEES - If the exposure measurement taken under paragraph (c)(2) of this section reveals employee exposure to airborne concentrations of isoamyl acetate 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 isoamyl acetate 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 isoamyl acetate 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 isoamyl acetate 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 isoamyl acetate 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 isoamyl acetate 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) In the design of open surface tank ventilation for the purposes of compliance with section 1910.94 (d), operations involving isoamyl acetate shall be classified as B-3 at 70 F.

(iii) Where a fan is located in duct work and where isoamyl acetate is present in concentrations greater than 2500 ppm, one fourth of the lower flammable limit, the fan rotating element 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.

(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),(f) and (g).

TABLE 2. RESPIRATORY PROTECTION FOR ISOAMYL ACETATE

Condition	Permissible Respiratory Protection
Vapor Concentration	
Equal to or Less than 1000 ppm	organic vapor cartridge(s). A gas mask with a chin-style or 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 1000 ppm or, Entry and Escape from Unknown Concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand (positive pressure) mode. air respirator with a full facepiece operated in pressure- an auxiliary self-contained air supply operated in pressure-demand mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece

operated in pressure-demand (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 isoamyl acetate which is contained in Appendix B in order to ensure the safe handling and use of isoamyl acetate.

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

(2) Portable fire extinguishers - For the purposes of compliance with section 1910.157, isoamyl acetate 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 isoamyl acetate shall be Class I Group D.

(4) Flammable liquids - For the purposes of compliance with section 1910.106, liquid isoamyl acetate 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 isoamyl acetate is handled, used or stored in a manner so as to create a potential fire or explosion hazard.

(6) Storage - Isoamyl acetate shall be stored so as not to come in contact with nitrates, strong oxidizers, strong alkalies or strong acids.

(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 isoamyl acetate. Face shields shall comply with section 1910.133(a)(6).

(ii) Employers shall ensure that clothing which becomes wet with liquid isoamyl acetate be removed immediately and not reworn until the isoamyl acetate 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 isoamyl acetate may occur.

(h) Spills

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

(2) Isoamyl acetate liquid 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 wet with liquid isoamyl acetate promptly wash or shower as necessary to remove any isoamyl acetate from the skin.

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

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

(2) Medical -

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

(II) Instruct the employees to advise the employer of the development of signs and symptoms of exposure to isoamyl acetate 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 isoamyl acetate.

(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 isoamyl acetate, or airborne concentrations of isoamyl acetate at or above the action level, a written statement as to whether such employee has a history of any of the following:

(I) Chronic lung disease
(II) Skin disease
(III) Kidney disease
(IV) Liver 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 isoamyl acetate.

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

(7) Exclusion or Removal from Exposure - No employee shall continue to be exposed to isoamyl acetate 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 isoamyl acetate.

(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 for isoamyl
(II) A description of the employee's duties as they relate to his exposure to isoamyl acetate;
(III) A description of any personal protective equipment 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 isoamyl acetate 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 isoamyl acetate.

(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 isoamyl acetate.

(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 for at least one year.

(2) Exposure measurements.

(i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to isoamyl acetate.

(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 isoamyl acetate 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 for 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 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 for at least one year.

(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 isoa

(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 isoamyl acetate which is conducted pursuant to this section.

(2) Exercise of opportunity to observe monitoring.

(i) When observation of the monitoring of employee exposure to isoamyl acetate 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 isoamyl acetate 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 isoamyl acetate 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.

Acetate

APPENDIX A

SUBSTANCE SAFETY DATA SHEET

I. SUBSTANCE IDENTIFICATION

SUBSTANCE: Isoamyl acetate

PERMISSIBLE EXPOSURE: 100 parts of isoamyl acetate vapor per million parts of air (ppm) or 525 milligrams of isoamyl acetate vapor per cubic meter of air (mg/cu m)

APPEARANCE AND ODOR: Clear colorless liquid with a banana-like odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Isoamyl acetate can affect your body if you inhale it or if it comes in contact with your skin or eyes or if you swallow it.

B. Effects of Overexposure:

1. Short-Term Overexposure: Overexposure to isoamyl acetate may cause irritation of the eyes, nose and throat. Overexposure may also cause headache, drowsiness and unconsciousness.
2. Long-Term Overexposure: Prolonged overexposure may cause irritation of the skin.
3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms associated with isoamyl acetate exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If isoamyl acetate gets into your eyes, wash the eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If clothing becomes wet with isoamyl acetate, immediately remove and clean the clothing before wearing again. If isoamyl acetate gets on your skin, flush the contaminated skin with water promptly. If there is skin irritation, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of isoamyl acetate 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: When isoamyl acetate has been swallowed get medical attention immediately. If medical attention is not immediately available get the affected person to vomit by having him touch the back of his throat with his finger or by giving him large amounts (one pint or more) of warm salt water (two tablespoons of salt per pint of water). Do not make an unconscious 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 equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. RESPIRATORS: Respirators are not the best way to control exposure to isoamyl acetate. You can only be required to wear them for routine use if your employer is in the process of installing controls or other 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.) If you can smell isoamyl acetate 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 and other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid isoamyl acetate.

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

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

Isoamyl acetate is a flammable liquid and its vapors easily form explosive mixtures with air. It must be stored in tightly closed containers in a cool, well-ventilated area away from heat, sparks and flames. Store isoamyl acetate away from nitrates, strong oxidizers, strong alkalies, and strong acids. Sources of ignition such as smoking and open flames are prohibited wherever isoamyl acetate is handled, used or stored in a manner that could create a potential fire or explosion hazard. You must use non-sparking tools when opening or closing metal containers of isoamyl acetate, and containers must be bonded and grounded when pouring or transferring liquid isoamyl acetate. If your skin becomes wet with liquid isoamyl acetate, you must promptly wash or shower as necessary to remove any isoamyl acetate from the skin. You must immediately remove any clothing that becomes wet with liquid isoamyl acetate and this clothing must not be reworn until the isoamyl acetate is removed from the clothing. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where isoamyl acetate is used in your work area and for any additional plant safety rules.

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APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
ISOAMYL ACETATE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Banana oil; 3-methyl-1-butanol acetate; 2-methylbutyl ethanoate
2. Formula: $CH_3COOCH_2CH_2CH(CH_3)_2$
3. Molecular weight: 130.2

B. Physical Data

1. Boiling point (760 mm Hg): 145.6 C (294 F)
2. Specific gravity (water=1): 0.87
3. Vapor density (air=1 at boiling point of isoamyl acetate): 4.5
4. Melting point: -100 C (-148 F)
5. Vapor pressure at 20 C (68 F): 4 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): 0.2
7. Evaporation rate (butyl acetate=1): 0.42
8. Appearance and odor: Clear colorless liquid with a banana - like odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 25 C (77 F) (closed cup)
2. Autoignition temperature: 360 C (680 F)
3. Flammable limits in air, % by volume: Lower: 1.0 at 100 C (212 F) Upper: 7.5
4. Extinguishing media: Dry chemical, carbon dioxide, foam.
5. Special fire-fighting procedures: Do not use solid stream of water since stream will scatter and spread fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Isoamyl acetate is a flammable liquid. Its vapors can easily form exposive mixtures with air. All ignition sources must be controlled where isoamyl acetate is used, handled or stored. Isoamyl acetate vapors are heavier than air and may travel along the ground and be ignited by sparks or open flames at locations remote from the site at which isoamyl acetate is handled.
7. For purposes of conforming to the requirements of 29 CFR 1910.106, isoamyl acetate is classified as a Class IC flammable liquid. At 2500 ppm, one-fourth of the lower flammable limit, isoamyl acetate 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 isoamyl acetate shall be Class I, Group D.

B. Reactivity
1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with nitrates, strong oxidizers, strong alkalies, and strong acids may cause fire and explosion.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving isoamyl acetate.
4. Special precautions: None

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If isoamyl acetate 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) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber. Isoamyl acetate 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:
Isoamyl acetate may be disposed of:
1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a sanitary land fill.
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 8-hour exposure may be determined from a single 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 8-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 isoamyl acetate 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 isoamyl acetate to plus or minus

25%. Methods meeting these accuracy requirements are available in the "NIOSH Monitoring Methods Manual".

V. MISCELLANEOUS PRECAUTIONS

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

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

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

D. Employers must advise employees of all plant areas and operations where exposure to isoamyl acetate could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to isoamyl acetate is likely to occur are: operations involved in its manufacture and in its use as a solvent for lacquers in films, coatings and adhesives.

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APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; insignificant skin absorption.

II. TOXICOLOGY

The toxicologic effects of isoamyl acetate are probably similar to those of amyl acetate, chiefly irritation of the conjunctiva and upper respiratory tract, followed by gradual onset of narcosis, with slow recovery after exposure ceases. Men exposed to 950 ppm isoamyl acetate for 30 minutes reported only irritation of the nose and throat, headache and weakness; cats exposed to 1900 ppm for 2-3 hours per day for a week showed only irritation, weakness and loss of weight; dogs exposed to 5000 ppm for one hour had nasal irritation and drowsiness. No chronic systemic effects have been reported in humans.

III. SIGNS AND SYMPTOMS

Irritation of the eyes, nose and throat; narcosis at high sustained levels. Skin exposure predisposes to dermatitis due to defatting effect.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

None specific. Remove from exposure, give artificial resuscitation if indicated, and wash eyes and contaminated skin.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of isoamyl acetate are caused by its irritant properties. It is important that the physician become familiar with plant operating conditions in which exposure to isoamyl acetate 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 examinations 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 isoamyl acetate exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

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

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

3. Kidney disease - Although isoamyl acetate is not known as a kidney toxin in humans, the importance of the organ in the elimination of toxic substances justifies special consideration in those with possible impairment of renal function.

4. Liver disease - Although isoamyl acetate 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 functions.

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. Browning, Ethel: Toxicity and Metabolism of Industrial Solvents, Elsevier Publishing Company, Amsterdam, 1965, pp. 539-542.

2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishers, New York, 1963, pp. 1857-1867.

3. von Oettingen, W. F.: "The Aliphatic Acids and Their Esters: Toxicity and Potential Dangers," A.M.A. Archives of Industrial Health, 21:28-65, 1960.

REFERENCES AND SOURCES
ISOAMYL ACETATE
1910.93

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

Eye: Grant, "Toxicology of the Eye"

Skin: Patty, "Industrial Hygiene and Toxicology;" Sax, "Dangerous Properties of Industrial Materials;" "Amyl Acetate," AIHA Hygienic Guide Series

Ingestion: Sax, "Dangerous Properties of Industrial Materials;" "Amyl Acetate," AIHA Hygienic Guide Series

COMMENTS

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

Grant reports, "experimentally, several drops of liquid amyl acetate (isoamyl acetate) squirted on the eyes of anesthetized rabbits and washed off with water two minutes later caused temporary corneal epithelial injury, but recovery was complete in a day or two. By standardized testing on rabbit eyes, amyl acetate has been graded only 2 (slightly injurious) on a scale of 1 to 10." This indicates that 0.5 ml of the undiluted chemical, after 24 hours, causes more than iritis with slight internal congestion or causes necrosis on less than 5% of the cornea, but in any case, produces less than "severe injury" as defined by Smyth and Carpenter. A classification of 2 is, therefore, concluded to be appropriate.

Skin - Classification: 2
Output statement numbers: 2, 7b, 21, 16i
Exceptions: None

Patty notes in general for esters that "the local effects on the skin are about the same as for other volatile solvents; defatting and cracking may occur. Specific sensitization dermatitis is negligible." Sax considers isoamyl acetate to be an acute and chronic local irritant of moderate toxic hazard. The Hygienic Guide for amyl acetate (some grades of which are predominantly isoamyl acetate) agrees that there is defatting action and notes that prolonged contact can cause irritation. The rabbit skin penetration LD50 is given as being greater than 20 ml/kg.

Isoamyl acetate has a vapor pressure of 4 mm Hg at 20 degrees C. It is 0.2% soluble in water and has a flash point of 77 degrees F.

A classification of 2 is concluded to be appropriate.

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

Sax considers isoamyl acetate to be a moderate toxic hazard locally and systemically by ingestion. The Hygienic Guide for amyl acetate (some grades of which are predominantly isoamyl acetate) gives an acute oral LD50 of 6.5 gm/kg for rats. It concludes that "ingestion is not a problem in

industry." The slight toxicity of the substance leads to the conclusion that ingestion would not present a hazard in the industrial environment.

SUBSTANCE TECHNICAL GUIDELINES
ISOAMYL ACETATE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Banana oil; 3-methyl-1-butanol acetate; 2-methylbutyl ethanoate
2. Formula: $CH_3COOCH_2CH_2CH(CH_3)_2$
3. Molecular weight: 130.2

B. Physical Data

1. Boiling point (760 mm Hg): 145.6 C (294 F)
2. Specific gravity (water=1): 0.87
3. Vapor density (air=1 at boiling point of isoamyl acetate): 4.5
4. Melting point: -100 C (-148 F)
5. Vapor pressure at 20 C (68 F): 4 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): 0.2
7. Evaporation rate (butyl acetate=1): 0.42
8. Appearance and odor: Clear colorless liquid with a banana - like odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 25 C (77 F) (closed cup)
2. Autoignition temperature: 360 C (680 F)
3. Flammable limits in air, % by volume: Lower: 1.0 at 100 C (212 F) Upper: 7.5
4. Extinguishing media: Dry chemical, carbon dioxide, foam.
5. Special fire-fighting procedures: Do not use solid stream of water since stream will scatter and spread fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Isoamyl acetate is a flammable liquid. Its vapors can easily form exposive mixtures with air. All ignition sources must be controlled where isoamyl acetate is used, handled or stored in a manner that coulr create a potential fire or explosion hazard. Isoamyl acetate vapors are heavier than air and may travel along the ground and be ignited by sparks or open flames at locations remote from the site at which isoamyl acetate is handled.
7. For purposes of conforming to the requirements of 29 CFR 1910.106, isoamyl acetate is classified as a Class IC flammable liquid. For example, 2500 ppm, approximately one-fourth of the lower flammable limit, is one situation in which isoamyl acetate 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 isoamyl acetate shall be Class I, Group D.

B. Reactivity
1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with nitrates, strong oxidizers, strong alkalies, and strong acids may cause fire and explosion.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving isoamyl acetate.
4. Special precautions: None

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If isoamyl acetate is spilled or leaked, the following steps should be taken:
1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for vapors to completely clear hood ductwork, then burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber. Isoamyl acetate 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: Isoamyl acetate may be disposed of 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 8-hour exposure may be determined from a single 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 8-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 isoamyl acetate 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 isoamyl acetate to plus or minus 25%. Methods meeting these accuracy requirements are available in the "NIOSH Monitoring Methods Manual".

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V. MISCELLANEOUS PRECAUTIONS

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

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

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

D. Employers should advise employees of all plant areas and operations where exposure to isoamyl acetate could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to isoamyl acetate is likely to occur are: operations involved in its manufacture and in its use as a solvent for lacquers in films, coatings and adhesives.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Isoamyl acetate

D. O. L. STANDARD: 100 ppm

WARNING PROPERTIES:

Odor Threshold: By analogy to amyl acetate, which has an odor threshold of 7 ppm (Handbook of Industrial Organic Solvents), the odor of isoamyl acetate is assumed to be detectable below the permissible exposure limit (100 ppm).

Eye Irritation Level: The Handbook of Industrial Organic Solvents indicates that significant eye and nose irritation does not occur below the threshold limit.

Other Information: According to the Documentation of TLV's, the "threshold limit of 100 ppm is recommended to prevent significant irritation of the respiratory passages."

Evaluation of Warning Properties: By analogy to amyl acetate, the odor threshold of isoamly acetate is assumed to be below the TLV. For the purposes of this standard, therefore, isoamyl acetate is treated as a material with good warning properties. Gas sorbent respiratory equipment is permitted.

IDLH: 3000 ppm

Basis for IDLH Value: This IDLH is based upon the report in the Documentation of TLV's that "slight narcotic effects were noted in cats exposed for six hours at 2800 ppm." This is the only useful information available upon which to base the IDLH.

Other Toxicological Information: The Documentation of TLV's gives the following information: "According to Flury and Wirth, slight narcotic effects were noted in cats exposed for six hours at 2800 ppm. Irritatio of eyes and salivation occurred at 1900 ppm. After six eight-hour exposures at 1900 ppm, necropsy indicated lung irritation and changes in the vital organs. Isoamyl acetate is considered to be 2.6 times as narcotic as ethyl acetate. According to Lehman and Flury, 24-hour exposures at 7200 ppm were fatal to cats. Human exposure for a half-hour at 1000 ppm resulted in irritation, dyspnea, increased pulse and fatigue. Amor stated that 1000 ppm caused serious toxic effects. Nelson et al. reported severe throat irritation from 200 ppm of amyl acetate and slight throat discomfort at 100 ppm in human subjects."

LFL: 10,000 ppm

VAPOR PRESSURE AT 20 C: 4 mm Hg
SATURATED CONCENTRATION AT 20 C: 5260 ppm

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and Supporting Documentation for ISOAMYL ACETATE

USE/EXPOSURE AND CONTROL DOCUMENT
ISOAMYL ACETATE

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of solvent vapor during spray application of varnishes and nitrocellulose lacquers as protective and finish coatings for wood (especially in the furniture industry), plastic, metal, leather and other surfaces	A	Local exhaust ventilation; personal protective equipment (respiratory protective devices, eye goggles)
2.	Inhalation of solvent vapor during application of varnishes and nitrocellulose lacquers as protective and finish coatings for wood, paper (as a printing ink vehicle), metal, leather and other surfaces by dipping, roller coating, tumbling, knifing or brushing	A	General dilution ventilation; local exhaust ventilation
3.	Inhalation of solvent vapor during air or oven drying of varnishes and lacquers	A	General dilution ventilation
4.	Inhalation of solvent vapor during application of cellulosic adhesives by machine spraying, dipping, roller coating, tumbling, knifing, or brushing. Most common applications are in shoe manufacturing, book binding, packaging, leather processing, paper processing and textiles	A	General dilution ventilation; local exhaust ventilation
5.	Inhalation of solvent vapor and skin contact with liquid during manual application of cellulosic adhesives (including household cements)	A,B	General dilution ventilation; local exhaust ventilation; personal protective equipment (gloves and aprons)
6.	Inhalation of vapor during the manufacture of shoe polish and furniture polish	A	General dilution ventilation
7.	Inhalation of vapor during fermentation of whiskey grains	A	General dilution ventilation

8.	Inhalation of solvent vapor during the manufacture of cellulosic photographic films by formation from solvent solutions	A	General dilution ventilation; local exhaust ventilation
9.	Inhalation of vapor during preparation of perfumes, foods, and other materials in which isoamyl acetate is used as a flavoring or an odorant	A	General dilution ventilation
10.	Inhalation of vapor during use as an extractant in the manufacture (purification) of pharmaceuticals such as penicillin	A	General dilution ventilation; local exhaust ventilation
11.	Inhalation of vapor and skin contact with liquid during cleaning and maintenance of acetate processing equipment such as kettles, distillation columns, and storage vessels	A,B	Personal protective equipment (respiratory protective devices (self-contained breathing apparatus or organic vapor masks), gloves, aprons, barrier creams, eye goggles)
12.	Inhalation of vapor during the manufacture of bath sponges	A	General dilution ventilation
13.	Inhalation of solvent vapor during the manufacture of artifical leathers	A	General dilution ventilation; local exhaust ventilation
14.	Inhalation of solvent vapor during the manufacture of artifical silk, rayon and pearls	A	General dilution ventilation; local exhaust ventilation
15.	Inhalation of solvent vapor during the manufacture and use of bronzing liquids	A	General dilution ventilation; local exhaust ventilation
16.	Inhalation of vapor when used in dry cleaning preparation	A	General dilution ventilation
17.	Inhalation of solvent and skin contact with liquid during treating of natural leathers (tannings)	A,B	General dilution ventilation; local exhaust ventilation; personal protective equipment (gloves and aprons)

18.	Inhalation of solvent vapor during dying, dry printing and other finishing processes for textiles	A	General dilution ventilation; local exhaust ventilation
19.	Inhalation of solvent vapor during application of phosphorous in the manufacture of fluorescent lamps	A	General dilution ventilation; local exhaust ventilation

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