# Occupational Health Guideline for Isoamyl Alcohol

## INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

## SUBSTANCE IDENTIFICATION

- Formula: $(CH_3)_2CHCH_2CH_2OH$
- Synonyms: 3-Methyl-1-butanol; isobutylcarbinol; isopentyl alcohol; fermentation amyl alcohol; fusel oil
- Appearance and odor: Colorless liquid with an alcoholic odor that causes coughing.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for isoamyl alcohol is 100 parts of isoamyl alcohol per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 360 milligrams of isoamyl alcohol per cubic meter of air ($mg/m^3$).

## HEALTH HAZARD INFORMATION

- **Routes of exposure**

Isoamyl alcohol can affect the body if it is swallowed, is inhaled, or comes in contact with the skin or eyes.

- **Effects of overexposure**

*1. Short-term Exposure:* Overexposure to isoamyl alcohol may cause irritation of the eyes and respiratory tract, headache, dizziness, shortness of breath, cough, nausea, vomiting, and diarrhea. Double vision, deafness, delerium, and death may occur. Coma, sugar in the urine, and blood changes have also been reported.
*2. Long-term Exposure:* Drying and cracking of the skin may result from prolonged or repeated skin exposure.
*3. Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to isoamyl alcohol.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to isoamyl alcohol at potentially hazardous levels:
*1. Initial Medical Screening:* Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from isoamyl alcohol exposure.

—Skin disease: Isoamyl alcohol is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Liver disease: Although isoamyl alcohol 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.

—Kidney disease: Although isoamyl alcohol is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

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

*2. Periodic Medical Examination:* Any employee developing the above-listed conditions should be referred for further medical examination.

- **Summary of toxicology**

Isoamyl alcohol vapor is a mild irritant. Among the few reports of experience with the amyl alcohols, exposure of rats to vapor at 8000 ppm was not lethal. Chemically related alcohols are considered to have predominantly narcotic properties at high concentrations. Slight throat irritation has been observed in unacclimated subjects at 100 ppm and objectionable irritation of the eyes, nose, and throat at higher concentrations. No chronic system-



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ic effects from isoamyl alcohol have been reported in humans.

## CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
  1. Molecular weight: 88
  2. Boiling point (760 mm Hg): 132 C (270 F)
  3. Specific gravity (water = 1): 0.8
  4. Vapor density (air = 1 at boiling point of isoamyl alcohol): 3.0
  5. Melting point: −117 C (−179 F)
  6. Vapor pressure at 20 C (68 F): 2 mm Hg
  7. Solubility in water, g/100 g water at 20 C (68 F): 2.4
  8. Evaporation rate (butyl acetate = 1): 0.2
- **Reactivity**
  1. Conditions contributing to instability: Heat
  2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
  3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving isoamyl alcohol.
  4. Special precautions: Isoamyl alcohol will attack some forms of plastics, rubber, and coatings.
- **Flammability**
  1. Flash point: 42.8 C (109 F) (closed cup)
  2. Autoignition temperature: 350 C (662 F)
  3. Flammable limits in air, % by volume (at 212 F): Lower: 1.2; Upper: 9.0
  4. Extinguishant: Alcohol foam, dry chemical, carbon dioxide
- **Warning properties**
  1. Odor Threshold: Quantitative information concerning the odor threshold is not available. The *Handbook of Industrial Solvents*, however, states that the odor of n-amyl alcohol is "apparent at approximately 60 ppm." May reports an odor threshold for amyl alcohol of 35 ppm, and Summer reports 10 ppm. By analogy, it is assumed that the odor of isoamyl alcohol is also below the TLV.
  2. Irritation Levels: Patty states that "according to Nelson et al., the following concentrations of 3-methyl-1-butanol (isoamyl alcohol) caused irritation of the respective mucous membranes of the majority of persons subjected to exposure for a few minutes: eyes, 150 ppm (0.54 mg/l); nose, 150 ppm; and throat, 100 ppm (0.36 mg/l)."
  3. Evaluation of Warning Properties: Because of its irritant effects and its odor, isoamyl alcohol is treated as a material with good warning properties.

## MONITORING AND MEASUREMENT PROCEDURES

- **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Method**

Sampling and analyses may be performed by collection of isoamyl alcohol vapors using an adsorption tube with subsequent desorption with 2-propanol in carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure isoamyl alcohol may be used. An analytical method for isoamyl alcohol is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

## RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

## PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid isoamyl alcohol.
- Clothing wet with liquid isoamyl alcohol should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of isoamyl alcohol from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the isoamyl alcohol, the person performing the operation should be informed of isoamyl alcohol's hazardous properties.
- Non-impervious clothing which becomes wet with liquid isoamyl alcohol should be removed promptly and

not reworn until the isoamyl alcohol is removed from the clothing.

• Employees should be provided with and required to use splash-proof safety goggles where liquid isoamyl alcohol may contact the eyes.

## SANITATION

• Skin that becomes wet with liquid isoamyl alcohol should be promptly washed or showered with soap or mild detergent and water to remove any isoamyl alcohol.

• Employees who handle liquid isoamyl alcohol should wash their hands thoroughly with soap or mild detergent and water before eating or smoking.

## COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to isoamyl alcohol may occur and control methods which may be effective in each case:

| Operation | Controls |
|---|---|
| Use as a vehicle, latent, or diluent solvent during application of paints, lacquers, varnishes, thinners, and paint removers | Local exhaust ventilation; general dilution ventilation |
| Use in synthesis of drugs and medicinals, as a solvent for alkaloids, and as an extractant of antibiotics in pharmaceutical industry | Local exhaust ventilation; general dilution ventilation |
| Use in manufacture of lacquers, paints, varnishes, thinners, and paint removers | Local exhaust ventilation; general dilution ventilation; personal protective equipment |
| Use as a chemical intermediate in organic synthesis of photographic chemicals, isoamyl acetate, and other esters | Local exhaust ventilation; general dilution ventilation; enclosed process; personal protective equipment |
| Liberation during manufacture and use of printing inks | Local exhaust ventilation; general dilution ventilation |
| Use as a solvent for resins, gums, waxes, and oils – perfumes, explosives, shoe cement, analytical determination for fat in milk, and artificial rubber | Local exhaust ventilation; general dilution ventilation; personal protective equipment |
| Liberation during manufacture and use in antifoaming agents and carburing fluids | Local exhaust ventilation; general dilution ventilation |
| Use in mining industry as a frothing agent for flotation of non-ferrous ores | Local exhaust ventilation; general dilution ventilation |
| Use as a vehicle solvent for celloidin solutions in microscopy | Local exhaust ventilation; general dilution ventilation |

## EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• **Eye Exposure**

If isoamyl alcohol gets into the eyes, wash 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.

• **Skin Exposure**

If isoamyl alcohol gets on the skin, promptly flush the contaminated skin with water. If isoamyl alcohol soaks through the clothing, remove the clothing promptly and flush the skin with water. If there is skin irritation, get medical attention.

• **Breathing**

If a person breathes in large amounts of isoamyl alcohol, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Swallowing**

When isoamyl alcohol has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• **Rescue**

Move the 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. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

## SPILL, LEAK, AND DISPOSAL PROCEDURES

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

• If isoamyl alcohol 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 evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and atomized in a suitable combustion chamber. Isoamyl alcohol should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

• Waste disposal methods:

Isoamyl alcohol 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.

## REFERENCES


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## RESPIRATORY PROTECTION FOR ISOAMYL ALCOHOL

| Condition | Minimum Respiratory Protection* Required Above 100 ppm |
|---|---|
| Vapor Concentration | |
| 1000 ppm or less | Any chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s). |
| 5000 ppm or less | A gas mask with a chin-style or a front- or back-mounted organic vapor canister.<br>Any supplied-air respirator with a full facepiece, helmet, or hood.<br>Any self-contained breathing apparatus with a full facepiece. |
| 8000 ppm or less | A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode. |
| Greater than 8000 ppm or entry and escape from unknown concentrations | Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.<br>A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode. |
| Fire Fighting | Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. |
| Escape | Any gas mask providing protection against organic vapors.<br>Any escape self-contained breathing apparatus. |

*Only NIOSH-approved or MSHA-approved equipment should be used.