NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND SUPPORTING DOCUMENTATION FOR

*** PHENYL ETHER-BIPHENYL MIXTURE ***

NIOSH/OSHA Draft Technical Standard and Supporting Documentation for PHENYL ETHER-BIPHENYL MIXTURE

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 PHENYL ETHER-BIPHENYL MIXTURE.

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 PHENYL ETHER-BIPHENYL MIXTURE

(a) DEFINITIONS

(1) PERMISSIBLE EXPOSURE - "Permissible Exposure" means inhalation of phenyl ether-biphenyl mixture in concentrations not in excess of 1 parts per million (ppm) (7 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 phenyl ether-biphenyl mixture.

(b) EMPLOYEE INFORMATION - Each employer who has a workplace in which phenyl ether-biphenyl mixture 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 PHENYL ETHER-BIPHENYL MIXTURE - Inform affected employees of the quantity, location, and manner of use or storage of phenyl ether-biphenyl mixture.

(c) EXPOSURE MEASUREMENT

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

(ii) Any measurements of airborne concentrations of phenyl ether-biphe taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to phenyl ether-biphenyl mixture; 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 phenyl ether-biphenyl mixture 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 phenyl ether-biphenyl mixture 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 phenyl ether-biphenyl mixture 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 phenyl ether-biphenyl 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 phenyl ether-biphenyl mixture 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 phenyl ether-biphenyl mixture 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 phenyl ether-biphenyl mixture 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 phenyl ether-biphenyl mixture is present in concentrations greater than 1250 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.

(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

(c) In work situations in which feasible engineering and work practice controls are insufficient to reduce employees 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 PHENYL ETHER - BIPHE MIXTURE

Condition	Permissible Respiratory Protection
Vapor Concentration	
Equal to or less than 50 ppm	and organic vapor cartridge(s) with dust, fume, and mist fil A gas mask with a chin-style or front or back mounted organic vapor canister with dust, fume, and mist filter. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece
Equal to or less than 100 ppm	operated in pressure-demand or other positive pressure mode with a full facepiece, hood, or helmet operated in continuous flow mode.
Greater than 100 ppm or Entry & Escape Unknown Concentrations	operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous flow mode an auxiliary self-contained air supply 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 phenyl ether-biphenyl mixture which is contained in Appendix B in order to ensure the safe handling and use of phenyl ether-biphenyl mixture.

(1) Electrical - For the purposes of compliance with section 1910.309, locations classified as hazardous locations due to the presence of liquid phenyl ether-biphenyl mixture shall be Class I Group D and for solid phenyl ether-biphenyl mixture shall be Class II Group G.

(2) Portable fire extinguishers - For the purposes of compliance with section 1910.157, phenyl ether-biphenyl mixture 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 of liquid phenyl ether-biphenyl mixture shall be Class I Group D and for solid phenyl ether-biphenyl mixture shall be Class II Group G.

(4) Combustible liquids - For the purposes of compliance with section 1910.106, liquid phenyl ether-biphenyl mixture is classified as a Class IIIB combustible liquid.

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

(6) Storage - Phenyl ether-biphenyl mixture shall be stored so as not to come in contact with strong oxidizers.

(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 or solid phenyl ether-biphenyl mixture. Face shields shall comply with section 1910.133(a)(6).

(ii) Employers shall ensure that non-impervious clothing which becomes wet with liquid phenyl ether-biphenyl mixture or contaminated with solid phenyl ether-biphenyl mixture be removed promptly and not reworn until the phenyl ether-biphenyl mixture 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 or solid phenyl ether-biphenyl mixture may occur.

(h) Spills

(1) Spills of phenyl ether-biphenyl mixture shall be cleaned up immediately after utilizing available ventilation.

(i) Sanitation

(1) Employers shall ensure that employees whose skin becomes wet with liquid phenyl ether-biphenyl mixture or contaminated with solid phenyl ether-biphenyl mixture, promptly wash or shower using soap or mild detergent to remove any phenyl ether-biphenyl mixture from the skin.

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

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

(2) Medical -

(I) Advise employees as to the signs and symptoms of exposure to phenyl ether-biphenyl mixture.

(II) Instruct the employees to advise the employer of the development of signs and symptoms of exposure to phenyl ether-biphenyl mixture 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 phenyl ether-biphenyl mixture.

(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 airborne concentrations of phenyl ether-biphenyl mixture 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) Kidney disease
(III) Chronic lung 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 phenyl ether-biphenyl mixture.

(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 phenyl ether-biphenyl mixture 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 phenyl ether-biphenyl mixture.

(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 phenyl ether-biphenyl mixture;

(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 phenyl ether-biphenyl mixture 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 phenyl ether-biphenyl mixture.

(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 phenyl ether-biphenyl mixture.

(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 phenyl ether - biphenyl mixture.

(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 phenyl ether - biphenyl mixture 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 phen
(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 phenyl ether - biphenyl mixture which is conducted pursuant to this section.

(2) Exercise of opportunity to observe monitoring.
(i) When observation of the monitoring of employee exposure to phenyl ether - biphenyl mixture 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 phenyl ether - biphenyl mixture 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 phenyl ether - biphenyl mixture 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.

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APPENDIX A

SUBSTANCE SAFETY DATA SHEET

I. SUBSTANCE IDENTIFICATION

SUBSTANCE: Phenyl ether-biphenyl mixture

PERMISSIBLE EXPOSURE: 1 part of phenyl ether-biphenyl mixture per million parts of air (ppm) or 7 milligrams of phenyl ether-biphenyl mixture per cubic meter of air (mg/cu m)

APPEARANCE AND ODOR: Straw-colored liquid that darkens on use with an aromatic, disagreeable odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Phenyl ether-biphenyl mixture can affect your body if you inhale it, swallow it, or if it comes in contact with your skin or eyes.

B. Effects of Overexposure:

1. Short-Term Overexposure: Overexposure to phenyl ether-biphenyl mixture may cause irritation of the eyes, nose and skin. It may also cause nausea.

2. Long-Term Overexposure: Repeated and prolonged contact 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 phenyl ether-biphenyl mixture exposure.

III. EMERGENCY FIRST AID PROCEDURES

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

B. Skin Exposure: If phenyl ether-biphenyl mixture gets on your skin, promptly wash the contaminated skin using soap or mild detergent together with powdered pumice, borax or other suitable cleanser. If phenyl ether-biphenyl mixture soaks through your clothing, remove the clothing promptly and wash the skin using soap or mild detergent together with powdered pumice, borax or other suitable cleanser. If irritation persists, get medical attention. Do not wear the clothing again until the phenyl ether-biphenyl mixture has been removed. Replace or repair impervious clothing that has developed leaks.

C. Breathing: If you or any other person breathes in large amounts of phenyl ether-biphenyl mixture 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 phenyl ether-biphenyl mixture 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 the 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 phenyl ether-biphenyl mixture. 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.) 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 phenyl ether-biphenyl mixture 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 or solid phenyl ether-biphenyl mixture.

C. EYE PROTECTION: You must wear splash-proof safety goggles (cup-cover type dust and splash safety goggles) where eye contact to

liquid phenyl ether-biphenyl mixture may occur. You must wear dust-proof safety goggles (cup-cover type dust and splash safety goggles) where eye contact to solid phenyl ether-biphenyl mixture may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

Liquid phenyl ether-biphenyl mixture is a combustible liquid and its vapors can form explosive mixtures with air at elevated temperatures. It must be stored in tightly closed containers in a well-ventilated area away from heat, sparks, flames and strong oxidizers. Sources of ignition such as smoking and open flames are prohibited wherever phenyl ether-biphenyl mixture is handled, used or stored in a manner that could create a potential fire or explosion hazard. If your skin becomes contaminated with solid phenyl ether-biphenyl mixture, you must promptly wash or shower using soap or mild detergent to remove the phenyl ether-biphenyl mixture from your skin. You must promptly remove any non-impervious clothing that becomes contaminated with solid phenyl ether-biphenyl mixture and this clothing must not be reworn until the phenyl ether-biphenyl mixture is removed from the clothing. If your skin becomes wet with liquid phenyl ether-biphenyl mixture, you must promptly wash or shower using soap or mild detergent together with powdered pumice, borax, or other suitable cleansers to remove the phenyl ether-biphenyl mixture from your skin. You must promptly remove any non-impervious clothing that becomes wet with liquid phenyl ether-biphenyl mixture and this clothing must not be reworn until the phenyl ether-biphenyl mixture 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 phenyl ether-biphenyl mixture is used in your work area and for any additional plant safety and health rules.

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APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
PHENYL ETHER - BIPHENYL MIXTURE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Dowtherm A; diphenyl oxide-diphenyl mixture
2. Formula: $(C_6H_5)_2O$ and $C_6H_5C_6H_5$
3. Molecular weight: 166 (average)

B. Physical Data

1. Boiling point (760 mm Hg): 257 C (495 F)
2. Specific gravity (water=1): 1.05-1.07
3. Vapor density (air=1 at boiling point of phenyl ether - biphenyl mixture): 5.7 (average)
4. Melting point: 12 C (54 F)
5. Vapor pressure at 25 C (77 F): 0.08 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): 0.0014
7. Evaporation rate (butyl acetate=1): Data not available
8. Appearance and odor: Straw-colored liquid that darkens on use with an aromatic, somewhat disagreeable odor.

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 124 C (255 F) (open cup)
2. Autoignition temperature: 621 C (1150 F)
3. Flammable limits in air, % by volume: Lower: 0.5; Upper: 6.2 (at 500 F)
4. Extinguishing media: Foam, dry chemical, carbon dioxide
5. Special fire-fighting procedures: Do not use a solid stream of water since a stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Phenyl ether-biphenyl mixture is a combustible liquid. At elevated temperatures its vapors can form explosive mixtures with air. All ignition sources must be controlled where phenyl ether-biphenyl mixture is used, handled or stored in a manner so as to create a potential fire or explosion hazard.
7. For purposes of complying with the requirements of 29 CFR 1910.106, phenyl ether-biphenyl mixture is classified as a Class IIIB combustible liquid.
8. For purposes of complying with the requirements of 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code liquid phenyl ether-biphenyl mixture shall be Class I, Group D, and solid phenyl ether-biphenyl mixture shall be Class II, Group G.

B. Reactivity

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

III. SPILL, LEAK AND DISPOSAL PROCEDURES

A. If phenyl ether-biphenyl mixture is spilled or leaked, the following steps should be taken:
1. Ventilate area of spill or leak
2. For small quantities, absorb or scoop up on paper. Large quantities may be reclaimed; however, if this is not practical, collect, dissolve in an appropriate solvent and atomize in a suitable combustion chamber.

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

C. Waste disposal methods:
Phenyl ether-biphenyl mixture may be disposed of by dissolving in an appropriate solvent and 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 8-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 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 phenyl ether-biphenyl 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 phenyl ether-biphenyl to plus or minus 25%. Methods meeting these accuracy requirements are available from NIOSH.

V. MISCELLANEOUS PRECAUTIONS

A. Store phenyl ether-biphenyl mixture in tightly closed containers in a well-ventilated area away from heat.

B. Employers must advise employees of all plant areas and operations where exposure to phenyl ether-biphenyl mixture could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to phenyl ether - biphenyl mixture is likely to occur are: during its use as a heat transfer fluid, such as Dowtherm A, and as a dye carrier.

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APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

Phenyl ether-biphenyl mixture is primarily an irritant to the eyes, skin and upper respiratory tract. Repeated 8 hour exposures at 182 mg/m3 of a vapor mist mixture were lethal to some animals within 1 1/2 months. Long-term studies (6 months) of four species at 7 to 10 ppm showed no significant adverse effects, although these concentrations are extremely nauseating to human subjects, and painfully irritating to the eyes and nose. While 1 ppm is tolerable to most individuals, the odor at 0.1 ppm may be objectionable to some persons. No chronic systemic effects have been reported in humans.

III. SIGNS AND SYMPTOMS

Irritation of the eyes, nose and skin; nausea.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Flush eyes and skin with water. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of phenyl ether-biphenyl mixture are caused by its irritant properties and objectionable odor. Biphenyl alone has been reported to cause central nervous system disorders and liver damage in humans. It is important that the physician becomes familiar with plant operating conditions in which exposure to phenyl ether-biphenyl mixture 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 phenyl ether-biphenyl mixture exposure. Only

those giving a positive history of these conditions must be referred for further medical examinations.

1. Skin disease -- Phenyl ether-biphenyl mixture can cause dermatitis on prolonged exposure. Persons with preexisting skin disorders may be more susceptible to the effects of this agent.

2. Liver disease -- Although phenyl ether-biphenyl mixture 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 -- Although phenyl ether-biphenyl mixture 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.

4. Chronic respiratory disease -- In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of phenyl ether-biphenyl mixture 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: "Phenyl Ether-Biphenyl Mixture (vapor)," (3d ed., 2d printing), Documentation of the Threshold Limit Values for Substances in Workroom Air, Cincinnati, 1974, p. 206.

2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1701-1704.

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(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. 31.

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

Eye and Skin: Patty, "Ind. Hyg. and Tox.;" Dow MSDS; Grant, "Toxicology of the Eye"

Ingestion: Patty, "Ind. Hyg. and Tox."

COMMENTS

Eye - Classification: 2 and 6
Output statement numbers: 10 and 12 combined into one statement
Exceptions: None

Patty notes that the "liquid may cause pain and transient irritat of the eyes." Dow MSDS states that mild to moderate inflammation will occur and that the material is "unlikely to cause injury." Grant gives details of an exposure of a worker to a spray of fine droplets and notes that after treatment of the eyes with a bland oil "examination . . . revealed no corneal injury." He continues "in 4 cases listed as corneal burns from diphenyl oxide, recovery was complete within 48 hours."

Classifications of 2 and 6 are therefore concluded to be appropriate.

Skin - Classification: 2 and 6
Output statement numbers: 2, 17g, 17i, 20a
Exceptions: See below

Patty notes that when applied daily to the ar of the rabbit, Dowtherm A produced but a slight irritation manifested by hyperem edema, exfoliation, hair loss, and enlargement of hair follicles. When applied daily to the rabbit's abdominal skin, with a cloth bandage, undiluted Dowtherm A produced hyperemia and blistering i three days. Patty further states that cases of persons who have displayed an idiosyncracy toward the material are so rare that th are of no practical importance. It is also noted that there is n indication that the material is readily absorbed through the skin Reporting a case where a worker was sprayed by fine droplets of t substance, Grant notes that "within 5 minutes he began to feel stinging and burning of the . . . skin about his eyes; his discom was relieved immediately when the . . . skin (was) washed with a bland oil."

This mixture has a melting point of 54 degrees F. Its vapor pressure is essentially zero at 20 degrees C. It is 0.001% solub in water and has a flash point of 255 degrees F.

Classifications of 2 and 6 are concluded to be appropriate. The hazard is, however, not considered serious enough to warrant use of statements 5b, 7a, and 7b.

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

Patty gives an oral LD100 for rats of 4.4 g/kg and notes tha the probability of harm from ingestion is remote because of its low acute toxicity, its low solubility in water, and its outstand odor and taste. It is further stated that rats given 0.5 g/kg doses 5 days a week until 132 doses had been administered only showed very slight depression of growth and slight weight increas of the liver and kidneys. Ingestion is therefore concluded not t be a hazard in the industrial environment.

NOTE: The flash point reported in Appendix B is an ADL measurement.

SUBSTANCE TECHNICAL GUIDELINES
PHENYL ETHER - BIPHENYL MIXTURE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Dowtherm A; diphenyl oxide-diphenyl mixture
2. Formula: $(C_6H_5)_2O$ and $C_6H_5C_6H_5$
3. Molecular weight: 166 (average)

B. Physical Data

1. Boiling point (760 mm Hg): 257 C (495 F)
2. Specific gravity (water=1): 1.05-1.07
3. Vapor density (air=1 at boiling point of phenyl ether - biphenyl mixture): 5.7 (average)
4. Melting point: 12 C (54 F)
5. Vapor pressure at 25 C (77 F): 0.08 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): 0.0014
7. Evaporation rate (butyl acetate=1): Data not available
8. Appearance and odor: Straw-colored liquid that darkens on use with an aromatic, somewhat disagreeable odor.

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 119 C (246 F) (closed cup)
2. Autoignition temperature: 621 C (1150 F)
3. Flammable limits in air, % by volume: Lower: 0.5; Upper: 6.2 (at 500 F)
4. Extinguishing media: Foam, dry chemical, carbon dioxide
5. Special fire-fighting procedures: Do not use a solid stream of water since a stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Phenyl ether-biphenyl mixture is a combustible liquid. At elevated temperatures its vapors can form explosive mixtures with air. All

ignition sources must be controlled where phenyl ether-biphenyl mixture is used, handled or stored in a manner that could create a potential fire or explosion hazard.

7. For purposes of complying with the requirements of 29 CFR 1910.106, phenyl ether-biphenyl mixture is classified as a Class IIIB combustible liquid.

8. For purposes of complying with the requirements of 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code liquid phenyl ether-biphenyl mixture shall be Class I, Group D, and solid phenyl ether-biphenyl mixture shall be Class II, Group G.

B. Reactivity

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

III. SPILL, LEAK AND DISPOSAL PROCEDURES

A. If phenyl ether-biphenyl mixture is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak
2. For small quantities, absorb or scoop up on paper. Large quantities may be reclaimed; however, if this is not practical, collect, dissolve in an appropriate solvent and atomize in a suitable combustion chamber.

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

C. Waste disposal methods: Phenyl ether-biphenyl mixture may be disposed of by dissolving in an appropriate solvent and 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 8-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 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 phenyl ether-biphenyl 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 phenyl ether-biphenyl to plus or minus 25%. Methods meeting these accuracy requirements are available from NIOSH.

V. MISCELLANEOUS PRECAUTIONS

A. Store phenyl ether-biphenyl mixture in tightly closed containers in a well-ventilated area away from heat.

B. Employers should advise employees of all plant areas and operations where exposure to phenyl ether-biphenyl mixture could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to phenyl ether - biphenyl mixture is likely to occur are: during its use as a heat transfer fluid, such as Dowtherm A, and as a dye carrier.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Phenyl ether - biphenyl mixture (vapor)

D. O. L. STANDARD: 1 ppm

WARNING PROPERTIES:

Odor Threshold: Patty states that "experience with human subjects has indicated that concentrations of vapors of Dowtherm A ranging from 0.1 to 1 ppm are readily detected by the olfactory organs and are unpleasant, sometimes producing nausea." The Documentation of TLV's states that the TLV of 1 ppm is recommended "to prevent disagreeable, nauseating odor for the majority of exposed workers. As little as 0.1 ppm may be objectionable to some sensitized exposed individuals. The TLV of 1 ppm is sufficiently low to prevent serious toxic effects, but may not eliminate all objectionable symptoms."

Irritation Levels: Grant states that "When concentrations of 3 or 4 ppm (phenyl ether - biphenyl mixture) in air are reached, there is irritation of the eyes, nose, and throat."

Evaluation of Warning Properties: Through its odor and irritant effects, phenyl ether - biphenyl mixture can be detected at a concentration within 3 times the permissible exposure limit. For the purposes of this standard, therefore, this mixture is treated as a material with good warning properties. Gas sorbent respiratory equipment is permitted.

IDLH: Unknown. Both Patty and the Documentation of TLV's report that concentrations of the vapor of phenyl ether - biphenyl mixture which are high enough to produce toxic effects from one 7-hour exposure cannot be attained. For the purposes of this standard, respirators have been selected on the basis of the protection factor afforded by each device up to a concentration of 100 ppm. High concentrations of the vapor are not likely to be encountered in the workplace because of the high boiling point and low vapor pressure of this material.

Other Toxicological Information: The Documentation of TLV's state that "considerable industrial experience has shown this mixture to

possess low toxicity. However, there have been occasional cases of mild skin irritation and complaints of unpleasant odor. The low toxicity has been borne out by animal studies in which single inhalation exposures of seven hours to the vapor. sufficient to cause overt toxicity, could not be attained. Repeated eight-hour exposures at 182 mg/m3 of vapor-mist mixture were lethal, however, to a significant number of animals within one and one-half months. Death was attributable to starvation because of refusal to eat. Nausea and vomiting was exhibited by the monkey, a symptom noted in man. Direct instillation of the undiluted liquid mixture into the eye of the rabbit caused pain and conjunctival irritation but not necrosis. Skin contact in the form of daily applications to the rabbit ear of the undiluted mixture caused slight irritation, exfoliation, hair loss, and enlargement of hair follicles; daily repeated applications with bandage produced blistering in three days. In industrial experience with man, however, skin reactions have been so rare as to be considered of no practical importance. Long-term studies (six months) involving four species of animals, including the monkey, showed no adverse effect by any of the five toxicologic criteria used at exposures of 7 to 10 ppm vapor.

"The vapors at these concentrations are extremely nauseating, and irritating to the eyes and upper respiratory tract."

Patty gives the following information concerning the acute oral toxicity of phenyl ether - biphenyl mixture (Dowtherm A): "rats and guinea pigs were fed by intubation single doses of Dowtherm A as manufactured. Guinea pigs also were fed Dowtherm A that had been in commercial use in a boiler for 5 years. The doses of the unused material permitting survival and causing the death of all rats were 2.0 and 4.4 g/kg, respectively; for guinea pigs these doses were 0.3 and 4.4 g/kg. When the used material was fed the corresponding dosages were 1.0 and 4.4 g/kg, indicating no change in acute oral toxicity as a result of prolonged commerical usage.

"Pecchiai and Saffiotti report the LD50 for Dowtherm A when administered as a 25 per cent solution in olive oil to be 5.66 + or - 1.28 g/kg for the rat. They observed degenerative changes in the liver and kidneys in surviving animals."

LFL: 5000 ppm
VAPOR PRESSURE AT 20 C: 0 mm Hg

USE/EXPOSURE AND CONTROL DOCUMENT
PHENYL ETHER - BIPHENYL MIXTURE

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor or mist when used as a high temperature heat transfer medium (marketed as Dowtherm A, Termax, Diphyl, and gilotherm). Condensing vapor is used in heating processes; liquid is used in heating and cooling processes. Applications are extensive throughout the chemical, petroleum, and nuclear industries.	A	General dilution ventilation; local exhaust ventilation; personal protective equipment (respiratory protective devices)
2.	Inhalation of vapor and skin contact with liquid during cleaning and maintenance of processing and storage equipment used with the mixture	A,B	Personal protective equipment (respiratory protective devices, gloves, aprons, goggles)
3.	Skin contact with liquid during use as a dye carrier (dyeing aid) for printing and dyeing polyester textiles. (The extent of this use is questioned as little information is available)	B	Personal protective equipment (gloves, aprons, goggles)

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