NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND SUPPORTING DOCUMENTATION FOR

*** GLYCIDOL ***

NIOSH/OSHA Draft Technical Standard and Supporting Documentation for GLYCIDOL

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 GLYCIDOL.

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.

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(a) DEFINITIONS

(1) PERMISSIBLE EXPOSURE - "Permissible Exposure" means inhalation of glycidol in concentrations not in excess of 50 parts per million (ppm) (150 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 glycidol.

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

(c) EXPOSURE MEASUREMENT

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

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

(iii) Any employee complaints of symptoms which may be attributable to exposure to glycidol; 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 glycidol 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 glycidol 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 glycidol 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 glycidol 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 glycidol 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 glycidol 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 glycidol 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 glycidol is present in concentrations greater than 5000 ppm, 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 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 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 GLYCIDOL

Condition	Permissible Respiratory Protection
Equal to or less than 250 ppm	or hood.
Equal to or less than 500 ppm	
Greater than 500 ppm or Entry & Escape from Unknown Concentrations	demand or other positive pressure or continuous flow mode and 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 with a full facepiece providing protection against organic vapors. Any escape self-contained breathing apparatus with a full facepiece, helmet, or hood.

(f) Fire and Safety

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

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

(2) Portable fire extinguishers - For the purposes of compliance with section 1910.157, glycidol 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 glycidol shall be class I Group C.

(4) Combustible liquids - For the purposes of compliance with section 1910.106, liquid glycidol is classified as a Class IIIA combustible 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 glycidol is handled, used or stored in a manner so as to create a potential fire or explosion hazard.

(6) Storage - Glycidol 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 glycidol. Face shields shall comply with section 1910.133 (a)(6).

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

(iii) Employers shall ensure that non-impervious clothing contaminated with liquid glycidol be removed promptly and not reworn until the glycidol 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 glycidol may occur.

(h) Spills

(1) Spills of glycidol shall be cleaned up immediately after utilizing available ventilation.

(i) Sanitation

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

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

(j) Training and Information - Each employer who has employees exposed to glycidol in excess of the action level, or employees who may have skin

or eye contact with liquid glycidol, or employees who work where accidental release, spill, fire, or explosion of glycidol may occur, shall annually:

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

(2) Medical -

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

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

(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 glycidol, or airborne concentrations of glycidol 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) Chronic lung disease

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

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

(5) Periodic Medical Examinations - The employer shall provide a medical examination for an employee if the employee advises the employer of the development of:

(I) Any of the medical conditions listed in (k)(2).

(II) Signs and symptoms listed in Appendix A which the employee suspects may be caused by exposure to glycidol.

(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 glycidol 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 glycidol.

(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 glycidol;

(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 glycidol 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 glycidol.

(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 glycidol.

(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 glycidol.

(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 glycidol 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 glycidol;

(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 glycidol which is conducted pursuant to this section.

(2) Exercise of opportunity to observe monitoring.

(i) When observation of the monitoring of employee exposure to glycidol 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 glycidol 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 glycidol 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: Glycidol (2,3 epoxy-1-propanol)

PERMISSIBLE EXPOSURE: 50 parts of glycidol per million parts of air (ppm) or 150 milligrams of glycidol per cubic meter of air (mg/cu m)

APPEARANCE: Colorless liquid

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Glycidol 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 glycidol may cause irritation of the eyes, nose and throat.

2. Long-Term Overexposure: Prolonged overexposure might produce irritation of the skin.

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

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If glycidol 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 glycidol gets on your skin, promptly wash the contaminated skin with water. If glycidol soaks through your clothing, remove the clothing promptly and wash the skin with water. If irritation persists, get medical attention. Do not wear the clothing again until the glycidol is removed. Replace or repair impervious clothing that has developed leaks.

C. Breathing: If you or any other person breathes in large amounts of glycidol 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 glycidol 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 glycidol. 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 the face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you experience irritation 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 glycidol.

C. EYE PROTECTION: You must wear splash-proof safety goggles (cup-cover type dust and splash safety goggles) if there is any possibility of liquid glycidol contacting your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

Glycidol 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 glycidol is handled, used, or stored in a manner that could create a potential fire or explosion hazard. If your skin becomes contaminated with liquid glycidol, you must promptly wash or shower to remove any glycidol from the skin. You must promptly remove any non-impervious clothing that becomes contaminated with liquid glycidol and this clothing must not be reworn until the glycidol is removed from the clothing. If you handle liquid glycidol, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where glycidol is used in your work area and for any additional plant safety and health rules.

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APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
GLYCIDOL

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: 2-Hydroxymethyloxiran; hydroxymethyl ethylene oxide; epoxypropyl alcohol; glycide; 3-hydroxypropylene oxide; 2,3-epoxy-1-propanol
2. Formula: C3H6O2
3. Molecular weight: 74

B. Physical Data

1. Boiling point (760 mm Hg): 166 C (331 F) decomposes
2. Specific gravity (water=1): 1.1
3. Vapor density (air=1 at boiling point of glycidol): 2.6
4. Melting point: -45 C (-49 F)
5. Vapor pressure at 25 C (77 F): 0.9 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): Miscible in all proportions
7. Evaporation rate (butyl acetate=1): Data not available
8. Appearance: Colorless liquid

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 72 C (162 F)(closed cup)
2. Autoignition temperature: Data not available
3. Flammable limits in air, % by volume: Data not available
4. Extinguishing media: Dry chemical, carbon dioxide, alcohol foam
5. Special fire-fighting procedures: Do not use a solid stream of water since a stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Glycidol is a combustible liquid. At elevated temperatures its vapors can form explosive mixtures with air. All ignition sources must be controlled where glycidol 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, glycidol is classified as a Class IIIA combustible liquid.
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 glycidol shall be Class I, Group C.

B. Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizing agents (especially nitrates) may cause fire and explosions.

3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving glycidol.
4. Special precautions: Glycidol will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK AND DISPOSAL PROCEDURES

A. If glycidol is spilled or leaked, the following steps should be taken:
1. Remove all ignition sources
2. Ventilate area of spill or leak
3. For small quantities, absorb on paper towels. Remove to a safe place (such as a fume hood) and burn the paper. Large quantities may be collected and atomized in a suitable combustion chamber, or absorbed in vermiculite, dry sand, earth or similar material and disposed of in a sanitary landfill.

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

C. Waste disposal methods:
Glycidol may be disposed of by dissolving in petroleum atomizing in a suitable combustion chamber, or absorbing in vermiculite, dry sand, earth or similar material and disposing of in a sanitary landfill.

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 glycidol 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 glycidol to plus or minus 25%. Methods meeting these accuracy requirements are available from NIOSH.

V. MISCELLANEOUS PRECAUTIONS

A. Store glycidol 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 glycidol could occur.

VI. COMMON OPERATIONS

Common operations in which high exposure to glycidol is likely to occur are: during its production; during the use of surface coatings containing glycidol; and its use during dye leveling, as a demulsifying agent and as a stabilizer for natural oils and vinyl polymers.

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APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

Glycidol vapor is an irritant to the eyes and upper respiratory tract, a skin irritant, and a central nervous system depressant. The LC50 for mice (4 hours) was 450 ppm, and for rats (8 hours) 580 ppm, resulting in pneumonitis, while rats exposed at 400 ppm daily showed only slight eye irritation and mild respiratory distress, with no evidence of systemic toxicity. Lethal doses of 0.45 to 0.85 g/kg of the liquid administered by gastric tube resulted initially in nervous system depression, but surviving animals showed a reversal of the depressant effect manifested by excitation and tremors. Direct application of the liquid to the skin of animals classifies glycidol as a moderate skin irritant; instilled into the eye it is classified as a severe eye irritant. Exposure to near-saturated vapor for eight hours resulted in corneal opacity. Repeated intramuscular injections do not affect hematopiesis in rats. The only report of toxic effects in humans is that of irritation of the eyes, nose and respiratory tract of experimenters working with the compound at room temperature.

III. SIGNS AND SYMPTOMS

Irritation of the eyes, nose and throat from vapor exposure; marked irritation of the eyes from splashing liquid; and irritation of the skin from prolonged contact. Narcosis may occur at sustained high levels.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Give artificial resuscitation if indicated. Flush eyes immediately with copious quantities of water. Wash skin with soap and water. If swallowed and the person is conscious, induce vomiting. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

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

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

2. Chronic respiratory disease -- In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of glycidol 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: "Glycidol," (3d ed., 2d printing), Documentation of the Threshold Limit Values for Substances in Workroom Air, Cincinnati, 1974, pp. 121-122.

2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1634-1635.

3. Hine, C.H. et al.: "Toxicology of Glycidol and Some Glycidyl Ethers," A.M.A. Archives of Industrial Health, 14:250-264, 1956.

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REFERENCES AND SOURCES
GLYCIDOL
1910.93

(d) Methods of Compliance

(1) Engineering Controls - In the absence of definitive data on the lowe flammable limit of glycidol, 5000 ppm was estimated to be the level above which non-sparking materials are required to minimize fire or explosion hazards from fan construction.

(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: Documentation in Support of TLV; Patty, "Ind. Hyg. and Tox.;" Grant, "Toxicology of the Eye"

Skin: Documentation in Support of TLV; Patty, "Ind. Hyg. and Tox;" Sax, "Dangerous Properties of Ind. Materials;" Biesele, J.J., Philips, F. S., Thiersch, J. B., Burchenal, J. H., Buckley, S. M., and Stock, C. C., "Chromosome Alteration and Tumour Inhibition by Nitrogen Mustards: The Hypothesis of Cross-Linking Alkylation," Nature, Vol. 166, No. 4235; Kodama, J. K., Guzman, R. J., Dunlap, M. Laquvam, G. S., Luna, R. and Hine, C. H. "Some Effects of Epoxy Compounds on the Blood," Arch. of Environ. Health, Vol. 2, no. 1 Jan

Ingestion: Sax, "Dangerous Properties of the Eye"

COMMENTS

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

Documentation of TLV's states that it is a severe eye irritant. Patty agrees. Grant states that glycidol is a reactive irritating substance and that application of a drop to eyes of rabbits has caused severe but reversible corneal injury.

Since injury caused is reversible, the substance is assigned a classification of 2.

Skin - Classification: 2
Output statement numbers: 2, 7a, 17g, 17i, 20a
Exceptions: None

Documentation of TLV's states "on the basis of primary irritation tests, glycidol is ranked as a moderate skin irritant. The percutaneous LD50 for rabbits is given as 1.98 g/kg. Patty agrees that contact produces moderate irritation and adds that repeated contact can cause localized deeply penetrated areas of skin necrosis. Sax agrees with acute local effects above and considers the acute systemic effects of skin absorption to be of moderate toxic hazard. Biesele et al. state that glycidol, in tissue culture tests, can cause structural chromosome changes. Tests by Kodama et al. where rats were given repeated intra-muscular injections of 100 mg/kg did not reveal hemopoietic tissu changes or weight changes. It is noted that monoepoxides have no been found to be active in the production or inhibition of cancer or to cause other radiomimetic effects.

The flash point of glycidol is 162 degrees F. It has a vapo pressure of 0.9 mm Hg at 25 degrees C and is miscible in all proportions with water.

A classification of 2 is concluded to be sufficient to preve the cited effects.

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

Intragastric LD50 of 0.85 g/kg for rats. Sax considers the acute local effects of ingestion to be of moderate toxic hazard.

A classification of 2 is concluded to be sufficient to preve ingestion of harmful amounts.

SUBSTANCE TECHNICAL GUIDELINES
GLYCIDOL

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: 2-Hydroxymethyloxiran; hydroxymethyl ethylene oxide; epoxypropyl alcohol; glycide; 3-hydroxypropylene oxide; 2,3-epoxy-1-propanol
2. Formula: C3H6O2
3. Molecular weight: 74

B. Physical Data

1. Boiling point (760 mm Hg): 166 C (331 F) decomposes
2. Specific gravity (water=1): 1.1
3. Vapor density (air=1 at boiling point of glycidol): 2.6
4. Melting point: -45 C (-49 F)
5. Vapor pressure at 25 C (77 F): 0.9 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): Miscible in all proportions
7. Evaporation rate (butyl acetate=1): Data not available
8. Appearance: Colorless liquid

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 72 C (162 F)(closed cup)
2. Autoignition temperature: Data not available
3. Flammable limits in air, % by volume: Data not available
4. Extinguishing media: Dry chemical, carbon dioxide, alcohol foam
5. Special fire-fighting procedures: Do not use a solid stream of water since a stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Glycidol is a combustible liquid. At elevated temperatures its vapors can form explosive mixtures with air. All ignition sources must be controlled where glycidol 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, glycidol is classified as a Class IIIA combustible liquid.
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 glycidol shall be Class I, Group C.

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

III. SPILL, LEAK AND DISPOSAL PROCEDURES

A. If glycidol is spilled or leaked, the following steps should be taken:
1. Remove all ignition sources
2. Ventilate area of spill or leak
3. For small quantities, absorb on paper towels. Remove to a safe place (such as a fume hood) and burn the paper. Large quantities may be collected and atomized 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: Glycidol may be disposed of:
1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.
2. By atomizing in a suitable combustion chamber.

IV. MONITORING AND MEASUREMENT PROCEDURES

a. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the average 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 glycidol 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 glycidol to plus or minus 25%.

Methods meeting these accuracy requirements are available from NIOSH.

V. MISCELLANEOUS PRECAUTIONS

A. Store glycidol 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 glycidol could occur.

VI. COMMON OPERATIONS

Common operations in which high exposure to glycidol is likely to occur are: during its production; during the use of surface coatings containing glycidol; and its use during dye leveling, as a demulsifying agent and as a stabilizer for natural oils and vinyl polymers.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Glycidol (2,3-epoxy-1-propanol)

D. O. L. STANDARD: 50 ppm

WARNING PROPERTIES:

Odor Threshold: There is no information available concerning the odor threshold of glycidol.

Eye Irritation Level: Grant states that "in vapor form, glycidol has proven damaging to the corneas of rats, but for human beings the vapor has been found to have adequate warning properties, consisting of eye and respiratory irritation, to preclude excessive industrial exposure." The Documentation of TLV's states that following the first few exposures, "rats exposed at 400 ppm glycidol seven hours a day for 50 days . . . (experienced) very slight irritation of the eyes, with slight lacrimation and encrustation of the eyelids . . ." No quantitative information is available concerning the threshold of eye irritation.

Evaluation of Warning Properties: Since there is no quantitative information available relating warning properties to air concentrations of glycidol, this substance is treated as a material with poor warning properties. Gas sorbent respiratory equipment is not permitted.

IDLH: 500 ppm

Basis for IDLH Value: This IDLH is based upon the 4-hour mouse LC50 of 450 ppm glycidol and the 8-hour rat LC50 of 580 ppm glycidol reported in the Documentation of TLV's and in Patty.

Other Toxicological Information: The Documentation of TLV's states that "rats exposed at 400 ppm glycidol seven hours a day for 50 days gave no evidence of systemic toxicity. Very slight irritation of the eyes, with slight lacrimation and encrustation of the eyelids, and slight respiratory distress were seen following the first few exposures. Except for a slight retardation of weight gain, compared with the controls, no evidence of cumulative toxicity could be detected. On the basis of primary irritation tests, glycidol is ranked as a moderate skin irritant and a severe eye irritant. The LC50 for mice (four hours) was 450 ppm, and for rats (eight hours) 580 ppm. Intragastric LD50 values were 0.45 and 0.85 g/kg respectively for mice and rats, while the percutaneous LD50 for rabbits was 1.98 g/kg. Predominant toxicological activity was depression of the central nervous system after intragastric administration. Animals that survived, exhibited

a reversal of the depressant effect with increased degree of activity of the central nervous system. Hypersensitivity to sound, vibration of the facial muscles and involuntary tremors were also seen. Corneal opacity resulted from eight hours exposure to near saturated vapor concentrations."

According to Patty, glycidol is a CNS stimulant. The cause of death is "central nervous system fatigue following central stimulation. Pulmonary irritation and emphysema (can be caused) when (glycidol is) inhaled."

Patty gives a skin penetration LD50 of 1.98 g/kg for the rabbit.

LFL: Data not available

VAPOR PRESSURE AT 25C: 0.9 mm Hg

SATURATED CONCENTRATION AT 25C: Approximately 1180 ppm

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for GLYCIDOL

USE/EXPOSURE AND CONTROL DOCUMENT
GLYCIDOL

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor and skin and eye contact with vapor and for liquid during use in surface coatings	A,B	General dilution ventilation; personal protective equipment (goggles, respiratory protective devices)
2.	Inhalation of vapor and skin and eye contact with vapor and/or liquid in the preparation of glycidol	A,B	General dilution ventilation; personal protective equipment (goggles, respiratory protective devices)
3.	Inhalation of vapor and skin and eye contact with vapor and/or liquid during chemical synthesis	A,B	General dilution ventilation; personal protective equipment (goggles, respiratory protective devices)
4.	Inhalation of vapor and skin and eye contact with vapor and/or liquid during use as a stabilizer for natural oils and vinyl polymers	A,B	General dilution ventilation; personal protective equipment (goggles, respiratory protective devices)
5.	Inhalation of vapor and skin and eye contact with vapor and/or liquid during use as a demulsifying agent	A,B	General dilution ventilation; personal protective equipment (goggles, respiratory protective devices)
6.	Inhalation of vapor and skin and eye contact with vapor and/or liquid during use as a dye-leveling (retarding) agent	A,B	General dilution ventilation; personal protective equipment (goggles, respiratory protective devices)

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