

I. RECOMMENDATIONS FOR A PHENOL STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that employee exposure to phenol in the workplace be controlled by compliance with the following sections. The standard is designed to protect the health and to provide for the safety of employees for up to a 10-hour workday, 40-hour workweek, over a working lifetime. Compliance with the standard should prevent adverse effects produced by exposure of employees to phenol. The standard is measurable by techniques that are valid, reproducible, and available. Sufficient technology exists to permit compliance with the recommended standard. The standard will be subject to review and revision as necessary.

These criteria and the recommended standard apply to exposure of employees to the aromatic organic compound C_6H_5OH , hereinafter referred to as phenol. "Phenol" in this recommended standard includes solids, aerosols, vapor, or solutions containing phenol.

"Occupational exposure to phenol" is defined as exposure to phenol at airborne concentrations exceeding one-half the recommended TWA environmental limit. Exposure at lower concentrations shall not require adherence to the following sections except for sections 3, 4(a), 4(b), 5, and 6.

Section 1 - Environmental (Workplace Air)

(a) Concentration

Occupational exposure to phenol shall be controlled so that no employee is exposed to phenol at concentrations greater than 20 mg/cu m in

air determined as a time-weighted average (TWA) concentration for up to a 10-hour workday, 40-hour workweek, or to more than 60 mg phenol/cu m of air as a ceiling concentration for any 15 minute period.

(b) Sampling and Analysis

Procedures for calibration of equipment, sampling, and analysis of phenol samples shall be as provided in Appendices I and II, or by any method shown to be equivalent in precision, accuracy, and sensitivity to the methods specified.

Section 2 - Medical

Medical surveillance shall be made available as specified below to all employees occupationally exposed to phenol, except that first-aid services shall be provided to any employee who is exposed to phenol by spills, splashes, or other means of skin or eye contact.

(a) Preplacement and periodic medical examinations shall be made available and shall include:

- (1) A comprehensive initial or interim work history.
- (2) A medical history which shall cover at least any history of preexisting disorders of the skin, respiratory tract, liver, and kidneys.
- (3) A physical examination of at least the cardiovascular system, respiratory tract, liver, kidneys, and skin. Routine blood tests and urine examination and such other biologic tests which are considered necessary by the responsible physician may also be included.
- (4) An evaluation of the employee's ability to use negative

or positive pressure respirators.

(5) An initial medical examination shall be made available within six months of the promulgation of a standard incorporating these recommendations.

(6) Periodic medical surveillance should be made available at an interval to be determined by the responsible physician for all employees occupationally exposed to phenol.

(b) Appropriate medical services and surveillance shall be provided to any employee with adverse health effects reasonably assumed or known to be due to exposure to phenol.

(c) Pertinent medical records shall be maintained for all employees occupationally exposed to phenol, and such records shall be kept for at least one year after the termination of employment.

(d) These records shall be available to the designated medical representatives of the Secretary of Health, Education, and Welfare, of the Secretary of Labor, of the employee or former employee, and of the employer.

Section 3 - Labeling and Posting

(a) All containers of phenol with capacity in excess of one kilogram and contents at a concentration of 1% phenol or greater shall bear the following label in addition to, or in combination with, label information required by other statutes, regulations, or ordinances:

- 4 Extreme Skin and Inhalation Hazard
- 2 Moderately Combustible
- 0 Nonreactive

PHENOL
(% Phenol by weight)

May be fatal if absorbed through skin, inhaled, or swallowed.
Rapidly absorbed through skin.
Causes severe burns of eyes and skin.

Do not breathe vapor or aerosol.
Do not get in eyes, on skin, or on clothing.
Do not take internally.

Wear goggles, face shield, gloves, and protective clothing
when handling.

FIRST AID

CALL A PHYSICIAN AS SOON AS POSSIBLE

In case of contact, immediately flush eyes or skin with
plenty of water for at least 15 minutes while removing
contaminated clothing and shoes. Wash clothing before
reuse.

If inhaled, remove victim to fresh air. Keep warm and quiet. If
breathing stops, give artificial respiration.

If swallowed, induce vomiting.

(b) In an area where phenol is used or handled, except in enclosed
systems and for systems in which the concentration of phenol is equal to or
less than 1%, the following sign shall be posted in readily visible
locations at or near all entrances to the area and on or near equipment
using or containing phenol:

DANGER!
PHENOL EXPOSURE AREA
Contact with phenol may be fatal.
Avoid any contact with skin or eyes.
Avoid breathing vapor or aerosol.

(c) In any area where there is bulk storage (greater than 55
gallons) of phenol or where phenol is used in a manner presenting the
potential or likelihood of overheating or igniting the phenol, the

following shall be added to the sign specified in Section 3(b):

Combustible Substance: Releases severely
injurious vapor on overheating or burning.

(d) If respirators are required for protection from phenol, the following statement shall be added in large letters to the sign required in Section 3(b):

RESPIRATORY AND SKIN PROTECTION REQUIRED IN THIS AREA

(e) In any workroom or area where there is likelihood of emergency situations arising from accidental skin, eye, or other excessive exposures to phenol and where signs are required by Section 3(b), they shall be supplemented by additional signs giving: emergency and first-aid instructions and procedures, the location of first-aid supplies and emergency equipment, including respiratory protective equipment, and locations of emergency showers and eyewash fountains.

(f) Signs shall be printed in English and in the predominant language of non-English-reading employees, if any, unless employers use equally effective means to ensure that non-English-reading employees know the hazards associated with phenol and the areas in which there is occupational exposure to phenol. Employers shall ensure that illiterate employees also know these hazards and the locations of these areas.

Section 4 - Personal Protective Equipment and Protective Clothing

Engineering controls and safe work practices shall be used to maintain exposure to airborne phenol at or below 20 mg/cu m, and protective clothing impervious to phenol shall be provided to prevent contact of phenol with the body surface. In addition, employers shall provide protective equipment and clothing to employees when airborne phenol exceeds 20 mg/cu m phenol in air. Emergency equipment shall be located at well-marked and identified stations and shall be adequate to the needs of all personnel to escape from the area or to safely cope with the emergency on reentry.

(a) Eye and Face Protection

(1) Cup-type or rubber-framed chemical safety goggles shall be worn by employees engaged in activities where it is likely that phenol may come in contact with the eye. With airborne phenol at concentrations in excess of 20 mg/cu m, a full-face mask respiratory protective device is required which will also provide adequate eye protection.

(2) Full-length, plastic face shields shall be worn in addition to safety goggles for face protection when working at tasks where contact with phenol is likely.

(3) Eye protection measures and equipment shall conform with the provisions of ANSI Z87.1-1968.

(b) Protective Clothing

(1) Employers shall provide and employees shall be required to wear gloves of neoprene, polyethylene, rubber, or other material impervious to phenol when working with phenol.

(2) Employers shall provide and employees shall be required to wear protective sleeves, aprons, jackets, trousers, caps, and shoes when needed for protection from skin contact with phenol. These garments shall be made of a material impervious to phenol.

(3) In emergencies or other circumstances involving exposure to airborne phenol at concentrations in excess of 20 mg/cu m, full body protective clothing shall be worn in addition to a respiratory protective device. The garments shall be of an impervious material and shall fit snugly about the wrists, neck, waist, and ankles.

(4) Employees handling drums, cans, or other containers of phenol shall wear impervious shoes or boots with safety toe-caps. Leather safety shoes shall be protected from splashes or spills by use of impervious coverings such as rubbers.

(5) In unusual, nonroutine, or emergency circumstances which may involve occasional periods of exposure to airborne phenol at concentrations in excess of 20 mg/cu m, clothing impervious to phenol vapor and aerosol shall be supplied by employers and shall be worn to supplement the required respiratory protection (see paragraph (c) below) in accordance with the requirements in Table I-1.

TABLE I-1

REQUIREMENTS FOR RESPIRATOR USAGE AND SKIN PROTECTION FOR EXPOSURE
AT CONCENTRATIONS IN EXCESS OF THE ENVIRONMENTAL LIMIT

Phenol Concentration	Respirator Type	Impervious Clothing
Less than 60 mg/cu m	(1) Chemical cartridge respirator with replaceable organic vapor cartridge with full facepiece. Maximum service life of 3 hours (2) Full-face gas mask, chin-type, with organic vapor canister. Maximum life of 4 hours	Required for any period of exposure over 8 hrs/day
Less than 200 mg/cu m	(1) Chemical cartridge respirator with replaceable organic vapor cartridge with full facepiece. Maximum service life of 3 hours (2) Full-face gas mask, chin-type, with organic vapor canister. Maximum life of 4 hours	Required for any period of exposure over 1.5 hrs/day
Less than 400 mg/cu m	(1) Full-face gas mask, chest- or back-mounted type, with industrial size organic vapor canister. Maximum service life of 2 hours (2) Type C supplied-air respirator, continuous-flow or pressure-demand type (positive pressure) with full facepiece	Required for any period of exposure over 0.5 hr/day
Greater than 400 mg/cu m	(1) Self-contained breathing apparatus with positive pressure in full facepiece (2) Combination supplied-air respirator, pressure-demand type, with auxiliary self-contained air supply (3) Type A supplied-air respirator with full facepiece and with motor-driven or hand-operated blower	Required for any period and for any such exposure

TABLE I-1 (CONTINUED)

REQUIREMENTS FOR RESPIRATOR USAGE AND SKIN PROTECTION FOR EXPOSURE
AT CONCENTRATIONS IN EXCESS OF THE ENVIRONMENTAL LIMIT

Phenol Concentration	Respirator Type	Impervious Clothing
Emergency (no concentration limit)	(1) Self-contained breathing apparatus with positive pressure in facepiece (2) Combination supplied-air respirator, pressure-demand type, with auxiliary self-contained air supply	Required for emer- gency work crew
Firefighting	(1) Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode	Required
Evacuation or escape (no concentration limit)	(1) Self-contained breathing apparatus in demand or pressure-demand mode (negative or positive pressure) (2) Full-face gas mask, front- or back- mounted type, with industrial size organic vapor canister	Not required

(c) Respiratory Protection

Respirators may be used for nonroutine operations, evacuation, or emergencies which may involve occasional brief exposures to phenol at concentrations in excess of 20 mg/cu m. Such exposures may occur during the period necessary to install or test required engineering controls or to take protective actions.

Appropriate respirators as described in Table I-1 may only be used pursuant to the following requirements:

(1) For the purpose of determining the type of respirator to be used, the employer shall measure the airborne phenol concentration in the workplace, initially and thereafter whenever process, worksite, climate, or control changes occur which are likely to increase the airborne concentration of phenol. This requirement does not apply when only positive pressure supplied-air respirators are used.

(2) The respirator and cartridge or canister used shall be of the appropriate class, as determined on the basis of the airborne concentration of phenol. The employer shall ensure that no employee is being exposed to phenol in excess of 20 mg/cu m as a TWA concentration because of improper respirator selection, fit, use, or maintenance.

(3) A respiratory protective program meeting the requirements of 29 CFR 1910.134 shall be established and enforced by the employer.

(4) The employer shall provide respirators in accordance with Table I-1 and shall ensure that the employee uses the respirator properly.

(5) Respiratory protective devices described in Table I-1 shall be those approved under provisions of 30 CFR 11.

(6) Respirators specified for use at greater airborne concentrations of phenol may be used in lesser airborne concentrations of phenol.

(7) Use of chemical cartridges and canisters more than once or for a period of time greater than that indicated in Table I-1 shall be prohibited.

(8) The employer shall ensure that respirators are adequately cleaned, maintained, and stored when not in use, and that employees are instructed on the use of respirators assigned to them and on how to test for leakage.

Section 5 - Informing Employees of Hazards from Phenol

(a) At the beginning of employment, or assignment for work at operations, or in an area which may involve overexposure to phenol, each employee shall be informed of the hazards of such employment and possible injuries due to phenol. He shall be instructed in the proper procedures for the safe handling and use of this compound, in the operation and use of protective systems and devices, and in appropriate emergency procedures.

(b) A continuing education program, conducted by a person or persons qualified by experience or special training, shall be instituted to ensure that all employees have current knowledge of job hazards, proper maintenance procedures and cleanup methods, and that they know how to use respirators correctly. The instructional program shall include a description of the general nature of the medical surveillance procedures

and why it is advantageous to the employee to undergo these examinations. As a minimum, instruction shall include the information in Appendix III, and this information shall also be made available in the work area and kept on file, readily accessible to the employee at all places of employment where overexposure may occur.

(c) Information shall be recorded on a "Material Safety Data Sheet" described in Appendix III or on a similar form required or approved by the Occupational Safety and Health Administration, US Department of Labor.

Section 6 - Work Practices

(a) Appropriate protective clothing and equipment (goggles, face shields, gloves, aprons, suits, or other personal protective equipment), as set forth in Section 4(a), shall be worn by each employee engaged in any operation at which there is the likelihood of splashes, spills, or other circumstances which may result in phenol coming into contact with the skin or eyes of an employee.

(b) Any workplace in which phenol is introduced into the air shall be adequately ventilated by either natural or mechanical means sufficient to control the airborne concentration of phenol to which any employee may be exposed to a value at or below 20 mg/cu m.

(c) Spills and leaks of phenol shall be cleaned up immediately. Employees engaged in such cleanup operations shall wear suitable protective clothing and equipment and respiratory protective devices. The cleanup operations shall be done or directly supervised by employees instructed and trained in the procedures for the safe decontamination or disposal of

equipment, materials, and waste. All other persons shall be excluded from the area of the spill or leak until cleanup is complete and safe conditions have been restored.

(d) Equipment and systems for using, handling, or transferring phenol shall be enclosed to the extent that is feasible for the operation or shall be otherwise designed or controlled to prevent skin or eye contact with, and overexposure to, phenol.

(e) Phenol shall be stored in closed containers in an area which is adequately ventilated to ensure that airborne phenol concentrations do not exceed the limits specified in Section 1(a).

(1) Storage conditions shall be controlled to prevent overheating and pressure buildup in phenol containers. Transfer and storage systems shall be designed and operated to prevent blockage by condensed phenol.

(2) When drums of phenol are heated to melt the contents, the use of open flames is prohibited. Drums shall be placed bung up with the bung loosened so that the internal pressure will be vented. Bungs shall be tightened prior to moving or handling drums.

(3) Bulk storage facilities shall be designed and constructed to contain any leaks or spills.

(4) Storage tanks shall be electrically grounded and bonded to transfer lines.

(5) Storage containers and transfer lines shall be maintained in good condition.

(f) Drums, carboys, or other containers of phenol shall be closed while they are being moved or handled. Transfer from such containers shall

be done carefully in a manner to prevent splashes, spills, or other possible circumstances by which any employee may come into contact with phenol.

(1) Leaking containers shall be isolated in adequately ventilated areas, or the phenol shall be transferred to an intact container. Employees shall wear adequate and appropriate personal and respiratory protective equipment during such operations.

(2) Shipping containers to be recycled shall be completely drained and securely sealed. Phenol shall be cleaned or flushed from the outside surfaces of the container.

(g) The transfer of phenol to or from tank trucks or cars may be done only at facilities designed and designated for such operations. The wheels of the tank vehicle shall be chocked, warning signs shall be displayed, and barriers shall be erected to prohibit entry of unauthorized personnel. Connections of the tank and the transfer system shall be compatible and clearly identified. Only trained, authorized persons may carry out the procedures.

(1) No transfer may be made unless authorized by a responsible supervisor.

(2) Employees authorized to make transfers shall be fully trained and familiar with the use of equipment and procedures.

(3) Open flames and smoking shall be prohibited in the area during transfer operations.

(4) The tank car or truck shall be electrically grounded and bonded to the transfer line and receiving tank.

(5) Employees engaged in sampling shall wear respiratory and body protection adequate to prevent overexposure.

(6) If leaks or spills occur, they shall be cleaned up immediately.

(h) Cleaning, maintenance, and repair of tanks, process equipment, and lines shall be done only by properly instructed and trained employees under responsible supervision. When possible, such work shall be accomplished from the outside of the tank or equipment. Entry into confined spaces, such as tanks, pits, tank cars, barges, process vessels, and tunnels, shall be controlled by a permit system. Permits shall be signed by an authorized representative of the employer certifying that preparation of the confined space, precautionary measures, and personal protective equipment are adequate, and that precautions have been taken to ensure that prescribed procedures have been followed.

(1) Before working on tanks, equipment, and lines, proper steps shall be followed to protect any employee from overexposure. Employees shall avoid contact with phenol-contaminated drainage or flushings which shall be drained to a phenol waste system.

(2) If the tank or equipment is to be entered, it shall be thoroughly ventilated after being cleaned. The air shall be tested to ensure that there is adequate oxygen and that exposure of employees is not in excess of 20 mg phenol/cu m in air.

(3) No employee shall enter any tank or equipment which does not have an entry large enough to admit an employee equipped with safety harness, lifeline, and appropriate respiratory equipment. The employee shall be able to leave the tank or vessel by the same opening.

(4) Employees entering contaminated tanks or equipment shall wear full body protective clothing until inspection and testing provide assurance of safety for personnel in the tank.

(5) An employee shall be stationed at the entry to keep employees in the tank under constant observation and one or more other employees shall be readily available in case of an emergency requiring rescue of any employee. An additional supplied-air or self-contained breathing apparatus with safety harness and lifeline shall be located outside the tank or vessel for emergency use.

(6) Provision shall be made for adequate ventilation of the tank or vessel to provide sufficient breathing air for any employee inside and to remove or purge any airborne phenol vapor in excess of 20 mg/cu m. The atmosphere in the tank or equipment shall be tested by appropriate direct-reading devices to ensure that the oxygen concentration is within safe limits.

(7) Before work in or on any tank, line, or equipment commences, provision shall be made for preventing inadvertent entry of phenol into the work area.

(8) Exterior work on a tank, vent, or equipment which may lead to leaking or ignition of phenol is prohibited until the item has been cleaned of phenol.

(i) Phenol waste and phenol-contaminated materials shall be treated or disposed of by methods which will prevent overexposure.

(j) Emergency showers and eyewash fountains shall be provided and maintained at locations readily accessible and close to all areas where phenol may contact the skin or eyes.

(k) Protective clothing, respirators, goggles, and other personal protective gear which have been contaminated by contact with phenol shall be thoroughly washed or cleaned before reuse by any employee. Contaminated shoes shall be discarded. Employers shall ensure that all such equipment is regularly inspected and maintained and that damaged items are repaired or replaced.

(1) Emergency plans and procedures shall be developed and employees shall be trained to implement the plans effectively.

(1) These procedures shall be reviewed with employees and shall be made available in the work areas.

(2) Appropriate emergency equipment including protective clothing and emergency and rescue breathing apparatus shall be located in a safe area adjacent to places where phenol overexposure could occur.

(3) During emergency situations, all personnel shall be evacuated from the area except for the trained and properly equipped emergency teams.

(m) The employer shall take the necessary steps to ensure that:

(1) Each employee receives adequate instruction and training in safe work practices and emergency procedures, and in the proper use of operational equipment and protective devices.

(2) Each employee annually receives refresher sessions and drills in safe work practices and emergency procedures.

(3) Each employee is informed of the locations of all emergency and first-aid equipment and supplies in the work area.

(4) Each employee is trained in the procedures and informed of his responsibility for reporting any emergency, exposure, or injury.

(5) Each employee is provided personal protective clothing and necessary safety devices.

(6) Each employee is given adequate, responsible supervision to ensure that all safety requirements and practices are followed.

(7) Only properly trained and authorized employees are permitted in areas in which overexposure to phenol is likely.

Section 7 - Sanitation

(a) Eating and food preparation or dispensing (including vending machines) shall be prohibited where phenol is present.

(b) Smoking shall be prohibited in areas where phenol is used, transferred, stored, or manufactured.

(c) Employees who handle phenol or equipment contaminated with phenol shall be instructed to wash their hands thoroughly with soap or mild detergent and water before eating or using toilet facilities.

Section 8 - Monitoring and Recordkeeping Requirements

(a) Workplace areas are not considered to have "occupational exposure" to phenol if airborne concentrations of phenol as determined on the basis of an industrial hygiene survey do not exceed 10 mg/cu m. Records of these surveys, including the basis for concluding that airborne concentrations of phenol do not exceed 10 mg/cu m or 20 mg/cu m as specified in Section 1(a) shall be maintained.

(b) Employers shall maintain records of exposure to airborne phenol based upon the following sampling and recording schedules:

(1) The first workplace environmental sampling shall be completed within six months of the promulgation of a standard incorporating these recommendations.

(2) In all monitoring, an adequate number of samples representative of the exposure in the breathing zone of the employees shall be collected to permit calculation of a TWA concentration exposure for a representative group of employees in every work operation involving phenol. This shall be performed quarterly for a minimum period of one year until it is verified that occupational exposure has not occurred. Thereafter, monitoring shall be performed annually unless there are changes in the production or process. When this occurs, monitoring shall again be conducted to determine each employee's exposure to phenol.

(3) Workplace environmental samples shall be taken within 30 days after installation of a new process or process changes.

(c) Should environmental sampling indicate airborne phenol concentrations between 10 mg/cu m and 20 mg/cu m, samples shall be collected in accordance with Appendix I and analyzed in accordance with Appendix II, or by equivalent or better methods for determination of the airborne phenol concentration.

(d) For work areas in which the phenol concentration exceeds 20 mg/cu m, corrective measures shall be initiated and monitoring shall be repeated on a weekly basis until two consecutive sampling periods have shown that airborne phenol concentrations have been reduced to 20 mg/cu m or below.

(e) Records of all sampling and analyses for phenol shall be maintained for at least one year. Records shall indicate the type of personal protective devices, if any, in use at the time of sampling. Records shall be maintained so that the exposure of each employee can be classified or characterized.

(f) Access to records

(1) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health or of the Director of the National Institute for Occupational Safety and Health.

(2) An employee's exposure determination and exposure measurement records required to be maintained by this section shall be made available to the employee or his designated representative upon request by the employee to the employer.

II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon which were prepared to meet the need for preventing occupational diseases arising from exposure to phenol. The criteria document fulfills the responsibility of the Secretary of Health, Education, and Welfare, under Section 20(a)(3) of the Occupational Safety and Health Act of 1970 to "...develop criteria dealing with the toxic materials and harmful physical agents and substances which will describe...exposure levels at which no employee will suffer impaired health or functional capacities or diminished life expectancy as a result of his work experience...."

The National Institute for Occupational Safety and Health (NIOSH), after a review of data and consultation with others, formalized a system for the development of criteria upon which standards can be established to protect employees from exposure to hazardous chemical and physical agents. Criteria for a recommended standard should enable management and labor to develop better engineering controls resulting in more healthful work environments, and mere compliance with the recommended standard should not be regarded as a final goal.

The criteria and recommended standard for phenol are part of a continuing series of documents published by NIOSH. The proposed standard applies only to the processing, manufacture, and use of phenol as applicable under the Occupational Safety and Health Act of 1970. The standard was not designed for the population-at-large, and any extrapolation beyond the occupational environment is not warranted. It is intended to (1) protect against injury from phenol, (2) allow measurement

by techniques that are valid, reproducible, and available to industry and governmental agencies, and (3) be attainable with existing technology.

There is sufficient information to develop a recommended standard for phenol, but research on effects produced by prolonged exposure to phenol at small concentrations is needed, either by animal studies or by epidemiologic investigations. Phenol in excess of normal physiologic capacities adversely affects nearly all organs, and an understanding of the mechanism of action would be useful in the prevention of adverse effects and for the development of a specific medical treatment for intoxication. Refinement of sampling and analytical techniques for phenol in workplace air would be useful. Well-controlled experiments regarding carcinogenesis, mutagenesis, and teratogenesis are needed.