NIOSH

CRITERIA FOR A RECOMMENDED STANDARD.... OCCUPATIONAL EXPOSURE TO

CRESOL

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health

criteria for a recommended standard....

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PREFACE

The Occupational Safety and Health Act of 1970 emphasizes the need for standards to protect the health and safety of workers exposed to an ever-increasing number of potential hazards at their workplace. The National Institute for Occupational Safety and Health has projected a formal system of research, with priorities determined on the basis of specified indices, to provide relevant data from which valid criteria for effective standards can be derived. Recommended standards for occupational exposure, which are the result of this work, are based on the health effects of exposure. The Secretary of Labor will weigh these recommendations along with other considerations such as feasibility and means of implementation in developing regulatory standards.

It is intended to present successive reports as research and epidemiologic studies are completed and as sampling and analytical methods are developed. Criteria and standards will be reviewed periodically to ensure continuing protection of the worker.

I am pleased to acknowledge the contributions to this report on cresol by NIOSH staff members and the valuable constructive comments provided by the Review Consultants on Cresol, the reviewers selected by the American Conference of Govermental Industrial Hygienists, and by Robert B.

O'Connor, M.D., NIOSH consultant in occupational medicine. The NIOSH recommendations for standards are not necessarily a consensus of all the consultants and professional societies that reviewed this criteria document on cresol. A list of review consultants and a list of the federal agencies to which the document was submitted are given on pages vi and vii.

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The Division of Criteria Documentation and Standards Development, National Institute for Occupational Safety and Health, had primary responsibility for the development of the criteria and recommended standard for cresol. David J. Brancato of this Division served as criteria manager. SRI International developed the basic information for consideration by NIOSH staff and consultants under contract No. CDC-99-74-31.

The Division review of this document was provided by Douglas L. Smith, Ph.D. (Chairman), Jon R. May, Ph.D., and Richard A. Rhoden, Ph.D., with Larry K. Lowry, Ph.D. (Division of Biomedical and Behavioral Science), Harry M. Donaldson (Division of Surveillance, Hazard Evaluations, and Field Studies), and Charles C. Hassett, Ph.D.

The views expressed and conclusions reached in this document, together with the recommendations for a standard, are those of NIOSH. These views and conclusions are not necessarily those of the consultants, other federal agencies or professional societies that reviewed the document, or of the contractor.

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      and Communicative Disease and Stroke

Consumer Product Safety Commission
  Bureau of Biomedical Science

Environmental Protection Agency
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I. RECOMMENDATIONS FOR A CRESOL STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that employee exposure to cresol in the workplace be controlled by adherence to the following sections. The standard is designed to protect the health and provide for the safety of employees for up to a 10-hour workshift, 40-hour workweek, over a working lifetime. Compliance with all sections of the standard should prevent adverse effects of cresol on the health and safety of employees. The standard is measurable by techniques that are valid, reproducible, and available to industry and government agencies. Sufficient technology exists to permit compliance with the recommended standard. Although the workplace environmental limit is considered a safe level based on current information, it should be regarded as the upper boundary of exposure and every effort should be made to maintain the exposure at levels as low as is technically feasible. The criteria and standard will be subject to review and revision as necessary.

In this document, the term "cresol" applies to the ortho, meta, or para isomer of the aromatic organic compound $CH_3C_6H_4OH$ or to any combination of the three isomers in a mixture. Examples of commercial mixtures that often contain cresol are the cresylic acids, which are generally defined as mixtures of cresol, xylenols, and phenol in which 50% of the material boils above 204 C. The criteria and recommendation for cresol will apply to cresylic acid mixtures that contain cresol. The term "cresols," as used in this document, applies to information concerning both cresol and cresylic acids. The individual cresol isomers will be specified

when they are known, as will the composition of cresylic acid mixtures. Cresol has three major uses in the United States; over 60% of the total amount produced is consumed in the production of wire enamel solvents, phosphate esters, and phenolic resins.

There is often confusion between cresol and two other products, creosol and creosote, which are not a part of this recommendation. "Creosol," $CH_3O(CH_3)C_6H_3OH$, is a methoxy derivative of o-cresol, while "creosote" is a mixture of phenol and phenol derivatives obtained from the distillation of coal tar or wood tar.

The similarities between cresol and phenol are particularly evident in cases of skin contact. Past proposed standards have been set with the underlying assumption that what is applicable for phenol should be applicable for cresol. This assumption is true for recommendations concerning work practices, but recent experimental evidence suggests that the phenol analogy should not be applied to cresol when setting an environmental limit. The recommended environmental limit for cresol is based on available information about the effects from both short- and long-term exposure to cresol. The standard is designed to safeguard workers occupationally exposed to airborne cresol from impairment of motor function and from damage to the liver, kidneys, and pancreas.

"Occupational exposure" to cresol, because of systemic effects, absorption through the skin on contact, and possible dermal irritation, is defined as work in any area where cresol is produced, processed, stored, or otherwise used. The "action level" is defined as one-half the recommended time-weighted average (TWA) environmental limit. Adherence to all provisions of the standard is required if an employee is occupationally

exposed to airborne cresol at concentrations in excess of the action level. If the employee is occupationally exposed at concentrations equal to or below the action level, then all sections of the recommended standard except sections 4(c)(2) and 8(a) shall be complied with because adverse effects can be produced by skin and eye contact. If exposure to other chemicals also occurs, provisions of any applicable standards for the other chemicals shall also apply.

Section 1 - Environmental (Workplace Air)

(a) Concentration

When skin contact is prevented, exposure to cresol shall be controlled so that no employee is exposed to cresol at a concentration greater than 10 milligrams per cubic meter (mg/cu m) of air (2.3 parts per million parts of air by volume), determined as a time-weighted average (TWA) concentration for up to a 10-hour workshift and 40-hour workweek.

(b) Sampling and Analysis

Procedures for the collection and analysis of environmental samples shall be as provided in Appendix I or by any other methods shown to be at least equivalent in precision, accuracy, and sensitivity to the methods specified.

Section 2 - Medical

Medical surveillance shall be made available as outlined below to all persons subject to occupational exposure to cresol.

(a) Preplacement medical examinations shall include at least:

(1) Comprehensive medical and work histories with special emphasis directed to any preexisting disorders, particularly of the lungs, liver, kidneys, pancreas, nervous and cardiovascular systems, and skin.

(2) A physical examination giving special attention to the lungs, liver, kidneys, pancreas, skin, and nervous and cardiovascular systems.

(3) A urinalysis that includes a microscopic examination. Additional tests, such as complete blood counts and liver and kidney function tests, should be considered by the responsible physician.

(4) An evaluation of the worker's ability to use positive and negative pressure respirators.

(b) Periodic examinations shall be made available on at least an annual basis. These examinations shall include at least:

(1) Interim medical and work histories.

(2) A physical examination as described in (a)(2) and (3) of this section.

(c) Employees complaining of skin abnormalities, such as scaling, crusting, or irritation, that may be attributed to exposure to cresol shall be medically evaluated.

(d) Initial medical examinations shall be made available to all workers as soon as practicable after promulgation of a standard based on these recommendations.

(e) Employees and potential employees having medical conditions that could be directly or indirectly aggravated by exposure to cresol shall be counseled on the increased risk of impairment of their health from

working with this substance. All employees occupationally exposed to cresol shall be informed about the value of periodic medical examinations.

(f) In an emergency involving cresol, all affected personnel shall be provided with immediate first aid, followed by prompt medical evaluation and care. In the event of skin or eye contact with liquid cresol, contaminated clothing and shoes shall be removed immediately, and skin and eyes shall be flushed with copious amounts of water. In cases of splashes, spills, or leaks where significant skin or eye contact with or inhalation of the material occurs, appropriate medical personnel shall be notified. Medical attendants shall be informed of the possibility of delayed systemic effects, and the persons so exposed shall be observed for a minimum of 72 hours. Medical examinations as described for the periodic examinations shall be made available as warranted by the results of the 72-hour observation period.

(g) Pertinent medical records shall be maintained by the employer for all employees occupationally exposed to cresol. Such records shall be retained for at least 30 years after termination of employment. Records of environmental exposures applicable to an employee shall be included in the employee's medical records. These records shall be made available to the designated medical representatives of the Secretary of Health, Education, and Welfare, of the Secretary of Labor, and of the employer, employee, or former employee.

Section 3 - Labeling and Posting

All labels and warning signs shall be printed both in English and in the predominant language of non-English-reading workers. Illiterate

workers and workers reading languages other than those used on labels and posted signs shall receive information regarding hazardous areas and shall be informed of the instructions printed on labels and signs.

(a) Labeling

All bulk containers that hold cresol shall carry, in a readily visible location, a label that bears the trade name of the product, if appropriate, and information on the effects of exposure to the compound on human health. The information shall be arranged as in the example below.

CRESOL
(Trade Name)

DANGER!

CAUSES SEVERE BURNS
MAY BE FATAL IF ABSORBED THROUGH SKIN,
INHALED, OR INGESTED

Do not get on skin, in eyes or mouth, or on clothing.
Avoid breathing vapor.
Keep containers closed when not in use.
Use only with adequate ventilation.
Wash thoroughly after handling.

First Aid: Call a physician immediately. In case of skin or eye contact, immediately remove contaminated clothing and flush skin or eyes with large amounts of water for at least 15 minutes. If material is inhaled, remove victim to fresh air. If victim is not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, give large quantities of water. Give at least 1 ounce of milk of magnesia or aluminum hydroxide gel in an equal amount of water. If these are not available, the whites of two or three eggs may be used. Do not induce vomiting. Never give anything by mouth to an unconscious person.

(b) Posting

In areas where exposure to cresol can occur, signs containing health hazard warning statements appropriate for this substance shall be posted in

readily visible locations. This information shall be arranged as in the example below.

DANGER!
CRESOL PRESENT IN AREA
(Isomer Name)

MAY BE FATAL IF ABSORBED THROUGH
SKIN, INHALED, OR INGESTED
CAUSES SEVERE BURNS

Do not get on skin, in eyes or mouth, or on clothing.
Avoid breathing vapor.

(c) When respirators are permitted under section 4(c), the following statement shall be added in large letters to the signs required in Section 3(b):

RESPIRATORY PROTECTION REQUIRED IN THIS AREA

(d) In any area where there is a likelihood of emergency situations arising, signs required by Section 3(b) shall be supplemented with signs giving emergency and first-aid instructions and procedures, the location of first-aid supplies and emergency equipment, and the locations of emergency showers and eyewash fountains.

Section 4 - Personal Protective Equipment

Engineering controls and safe work practices shall be used when needed to keep concentrations of airborne cresol at or below the prescribed limit and to minimize skin and eye contact. In addition, employers shall

provide protective equipment and clothing to employees when necessary.

(a) Eye Protection

Safety glasses with side shields shall be worn wherever there is occupational exposure to cresol. Chemical safety goggles or face shields (8-inch minimum) with goggles shall be provided by the employer and shall be worn during any operation in which particulate cresol may enter the eyes (29 CFR 1910.133).

(b) Skin Protection

Depending on the operations involved and the probable or likely extent of exposure, protective clothing and equipment, including gloves, aprons, suits, boots, and face shields (8-inch minimum) with goggles, shall be worn to prevent skin contact with particulate cresol.

(c) Respiratory Protection

(1) The use of respirators to achieve compliance with the recommended exposure limits is permitted only:

(A) During the time necessary to install or test the required engineering controls.

(B) During emergencies or during nonroutine operations, such as maintenance or repair activities, when the concentration of airborne cresol may exceed the permissible environmental limit.

(2) When use of a respirator is permitted, it shall be selected and used pursuant to the following requirements:

(A) The employer shall establish and enforce a respiratory protective program meeting the requirements of 29 CFR 1910.134.

(B) The employer shall provide respirators in accordance with Table I-1 and shall ensure that the employee uses the respirator provided when necessary. The respiratory protective devices provided in conformance with Table I-1 shall comply with the standards jointly approved by NIOSH and the Mining Enforcement and Safety Administration (MESA) as specified under the provisions of 30 CFR 11.

(C) Respirators specified for use in higher concentrations of cresol may be used in atmospheres of lower concentrations.

(D) The employer shall ensure that respirators are adequately cleaned and maintained and that employees are trained and drilled at least annually in the proper use and testing for leakage of respirators assigned to them.

(E) Respirators shall be easily accessible, and employees shall be informed of their location.

Section 5 - Informing Employees of Hazards

(a) Employees working in an area that may involve occupational exposure to cresol shall be verbally informed of the hazards of such employment, the symptoms associated with exposure to these substances, the appropriate emergency procedures to use, and the proper procedures for the safe handling and use of cresol.

TABLE I-1

RESPIRATOR SELECTION GUIDE FOR CRESOL

Concentration	Respirator Type Approved under Provisions of 30 CFR 11
Less than or equal to 500 mg/cu m	(1) Full facepiece respirator equipped with organic vapor canister or cartridge (2) Type C supplied-air respirator with full facepiece operated in demand (negative pressure) mode (3) Supplied-air impervious suit (4) Self-contained breathing apparatus with full facepiece operated in demand (negative pressure) mode
Less than or equal to 1,100 mg/cu m	(1) Type C supplied-air respirator with full facepiece operated in pressure-demand (positive pressure) mode (2) Type C supplied-air respirator operated in continuous-flow mode with full facepiece, hood, or helmet or impervious supplied-air suit
Greater than 1,100 mg/cu m or Emergency (entry into area of unknown concentration	(1) Self-contained breathing apparatus with full facepiece operated in pressure-demand mode or other positive pressure mode (2) Combination Type C supplied-air respirator with full facepiece operated in pressure-demand mode and auxiliary self-contained air supply

(b) A continuing education program, conducted on at least a yearly basis by qualified health and safety personnel, shall be instituted to ensure that employees whose jobs may involve exposure to cresol, including those engaged in maintenance and repair, have current knowledge of job hazards, proper maintenance procedures, and cleanup methods. Employees shall be informed of the general nature of the medical surveillance procedures and why it is advantageous to the workers to undergo these examinations. Each employee shall be told about the availability of the required information, which shall include, as a minimum, that prescribed in paragraph (c) of this section.

(c) Required information shall be recorded on the "Material Safety Data Sheet" shown in Appendix II or on a similar form approved by the Occupational Safety and Health Administration, US Department of Labor, and shall be kept on file, readily accessible to employees.

Section 6 - Work Practices

(a) Protective clothing and equipment, as set forth in Section 4, shall be worn by all employees engaged in operations where there is the possibility of skin or eye contact with particulate cresol.

(b) Engineering controls, such as process enclosure or local exhaust ventilation, shall be used as needed to keep airborne cresol within the recommended environmental limit.

(c) Equipment and systems used for handling and transferring cresol shall be enclosed to the extent feasible to prevent skin and eye contact. All equipment in which cresol is used shall be grounded,

including tanks, pipelines, and pumps.

(d) Storage, Handling, and General Work Practices

(1) Containers of cresol shall be kept tightly closed at all times when not in use. Storage shall be in well-ventilated areas away from heat and strong oxidizers. Containers shall be periodically inspected for leakage and deterioration.

(2) Written operating instructions and first-aid procedures shall be formulated and posted in areas where cresol is produced, processed, stored, or otherwise used.

(3) All equipment and systems used for handling and transferring cresol shall be inspected periodically for leaks. Valves, fittings, and connections shall be checked for tightness and good working order. Needed repairs and adjustments shall be made promptly.

(4) Before maintenance work is started, sources of cresol shall be eliminated from the affected area to the extent feasible. If the concentration of airborne cresol exceeds the recommended environmental limit, respiratory protective equipment shall be required during such maintenance work.

(5) Easily accessible, well-marked emergency showers and eyewash fountains shall be available in all work areas where cresol is produced, processed, stored, or otherwise used. In case of contact, the skin or eyes shall be flushed with large amounts of water for at least 15 mintues.

(6) Clothing that has become contaminated with cresol shall be either cleaned before reuse or disposed of. Contaminated clothing shall be kept in properly labeled, closed containers until it is laundered or

discarded. Anyone handling or responsible for cleaning contaminated clothing shall be informed about the hazards, relevant symptoms of overexposure, appropriate emergency procedures, and proper conditions and precautions for the safe handling of cresol. Materials that cannot be effectively decontaminated, such as leather and rubber, shall be discarded.

(7) Facilities, such as double lockers, shall be provided for each employee so clean and soiled clothing can be kept separate.

(8) Transportation and use of cresol shall comply with all federal, state, and local regulations.

(e) Emergency Procedures

Emergency plans and procedures shall be developed for all work areas where there is a potential for exposure to cresol. The measures shall include those specified below and any others considered appropriate for a specific operation or process. Employees shall be trained to implement the plans and procedures effectively.

(1) Prearranged plans shall be instituted for obtaining emergency medical care and for the transportation of injured workers. A sufficient number of employees shall be trained in first aid so that assistance is available immediately when necessary.

(2) Spills of cresol shall be cleaned up immediately. The area of the spill shall be posted and secured. Only authorized personnel, adequately protected and properly trained, shall be permitted to enter the area to shut off sources of cresol.

(3) Spilled liquids can be sorbed with vermiculite, dry sand, earth, or other appropriate material. If sufficient drainage to suitable collection basins is available, spilled liquid can be hosed away

with large quantities of water. Methods of waste disposal shall comply with federal, state, and local regulations.

(f) Confined Spaces

(1) Cleaning, maintenance, and repair of tanks, process equipment, and lines shall be performed only by properly trained, adequately protected, and supervised personnel.

(2) Entry into confined spaces, such as tanks, pits, tank cars, barges, and process vessels, shall be controlled by a permit system. Permits shall be signed by an authorized representative of the employer and shall certify 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 will be followed.

(3) Before they are entered, confined spaces shall be inspected and tested for oxygen deficiency and for the presence of cresol and other known or suspected contaminants.

(4) No employee shall enter any confined space that does not have an entry large enough to admit an employee wearing safety harness, lifeline, and appropriate respiratory equipment as specified in Section 4(c).

(5) Confined spaces shall be ventilated while work is in progress to keep the concentration of airborne cresol at or below the recommended environmental limit, to keep the concentration of other contaminants below dangerous levels, and to prevent oxygen deficiency.

(6) Anyone entering a confined space shall be observed from the outside by another properly trained and protected worker. An

additional supplied-air or self-contained breathing apparatus with safety harness and lifeline shall be located outside the confined space for emergency use. The person entering the confined space shall maintain continuous communication with the standby worker.

Section 7 - Sanitation

(a) Plant sanitation shall meet the requirements of 29 CFR 1910.141.

(b) Food preparation, dispensing (including vending machines), and eating shall be prohibited in areas where cresol is produced, stored, processed, or otherwise used.

(c) Smoking shall be prohibited in areas where cresol is produced, processed, stored, or otherwise used.

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

Section 8 - Monitoring and Recordkeeping Requirements

As soon as practicable after the promulgation of a standard based on these recommendations, employers shall determine by an industrial hygiene survey whether exposure to airborne cresol is in excess of the action level. Records of these surveys shall be kept, and if an employer concludes that air levels are at or below the action level, the records must show the basis for this conclusion. Surveys shall be repeated at least once every year and within 30 days of any process change likely to

result in an increased concentration of airborne cresol. When the industrial hygiene survey demonstrates that the environmental concentration of cresol exceeds the action level, the following requirements shall apply:

(a) Personal Monitoring

(1) A program of personal monitoring shall be instituted to identify and measure, or to permit calculation of, the exposure of each employee occupationally exposed to airborne cresol. Source and area monitoring may be used to supplement personal monitoring.

(2) In all personal monitoring, samples representative of the exposure to airborne cresol in the breathing zone of the employee shall be collected. Procedures for sampling and analysis of cresol shall be in accordance with Section 1(b).

(3) For each TWA concentration determination, a sufficient number of samples shall be taken to characterize employee exposures during each workshift. Variations in work and production schedules, as well as employee locations and job functions, shall be considered in decisions on sampling locations, times, and frequencies.

(4) Each operation shall be sampled at least once every 3 months or as otherwise indicated by a professional industrial hygienist. If an employee is found to be exposed at a level in excess of the TWA concentration limit, the exposure of that employee shall be measured at least once every week, control measures shall be initiated, and the employee shall be notified of the exposure and of the control measures being implemented. Such monitoring shall continue until two consecutive determinations, at least 1 week apart, indicate that employee exposure no

longer exceeds the environmental limit. Quarterly monitoring shall then be resumed.

(b) Recordkeeping

Records of environmental monitoring shall be kept for at least 30 years. These records shall include the dates and times of measurements, duties and location of the employees within the worksite, sampling and analytical methods used, number, duration, and results of the samples taken, TWA concentrations estimated from these samples, type of personal protective equipment used, if any, and employees' names. These records shall be available to the designated representatives of the Secretary of Labor, of the Secretary of Health, Education, and Welfare, of the employer, and of the employee or former employee.

II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon which were prepared to meet the need for preventing occupational disease or injury arising from exposure to cresol. 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 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 the health and to provide for the safety of employees exposed to hazardous chemical and physical agents. The criteria and recommended standards should enable management and labor to develop better engineering controls resulting in more healthful work environments, and mere compliance with the recommended standards should not be regarded as a final goal.

The criteria and recommended standard for cresol are part of a continuing series of documents published by NIOSH. The proposed standard applies to the processing, manufacture, and use of, or other occupational exposure to, cresol 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 protect against the development of systemic toxic effects and local effects on the skin and eyes of employees and be measurable by techniques that are valid, reproducible, and available to industry and governmental agencies.

The recommended standard for cresol applies to the individual cresol isomers either occurring alone or in various mixtures. Information found in the literature suggests that the toxicities of o-, m-, and p-cresol are similar and that exposure in the working environment is generally to a mixture of the three cresol isomers.

The major concern in occupational exposure to cresol is adverse effects on the skin, eyes, and respiratory tract. Cresol is both a vapor/aerosol hazard and liquid contact hazard that can result in severe chemical burns and systemic effects. The toxic effects from inhalation have not been adequately studied, but there is some information on the effects from short-term exposure. There is sufficient evidence to indicate that, when there is skin exposure, the toxicity of cresol is similar to that of phenol. In addition, the toxic effects produced by cresol and phenol given by routes of administration other than inhalation are also similar. Therefore, the recommended standard is based on available information on the effects of exposure to airborne cresol and on the similarities of acute toxicity between cresol and phenol that result from dermal contact with the compounds.

The development of the recommended standard for cresol suggested additional areas where further research would be beneficial. Studies, including epidemiologic studies, of the long-term health effects of exposure to cresol at concentrations around the recommended environmental

limit would aid in assessing the hazards of low-level exposure. Followup examinations of employees who have had skin contact with cresol would help to quantitate the risks of systemic effects from dermal exposure. Investigations of the carcinogenic, mutagenic, and teratogenic potential of cresol are also needed.