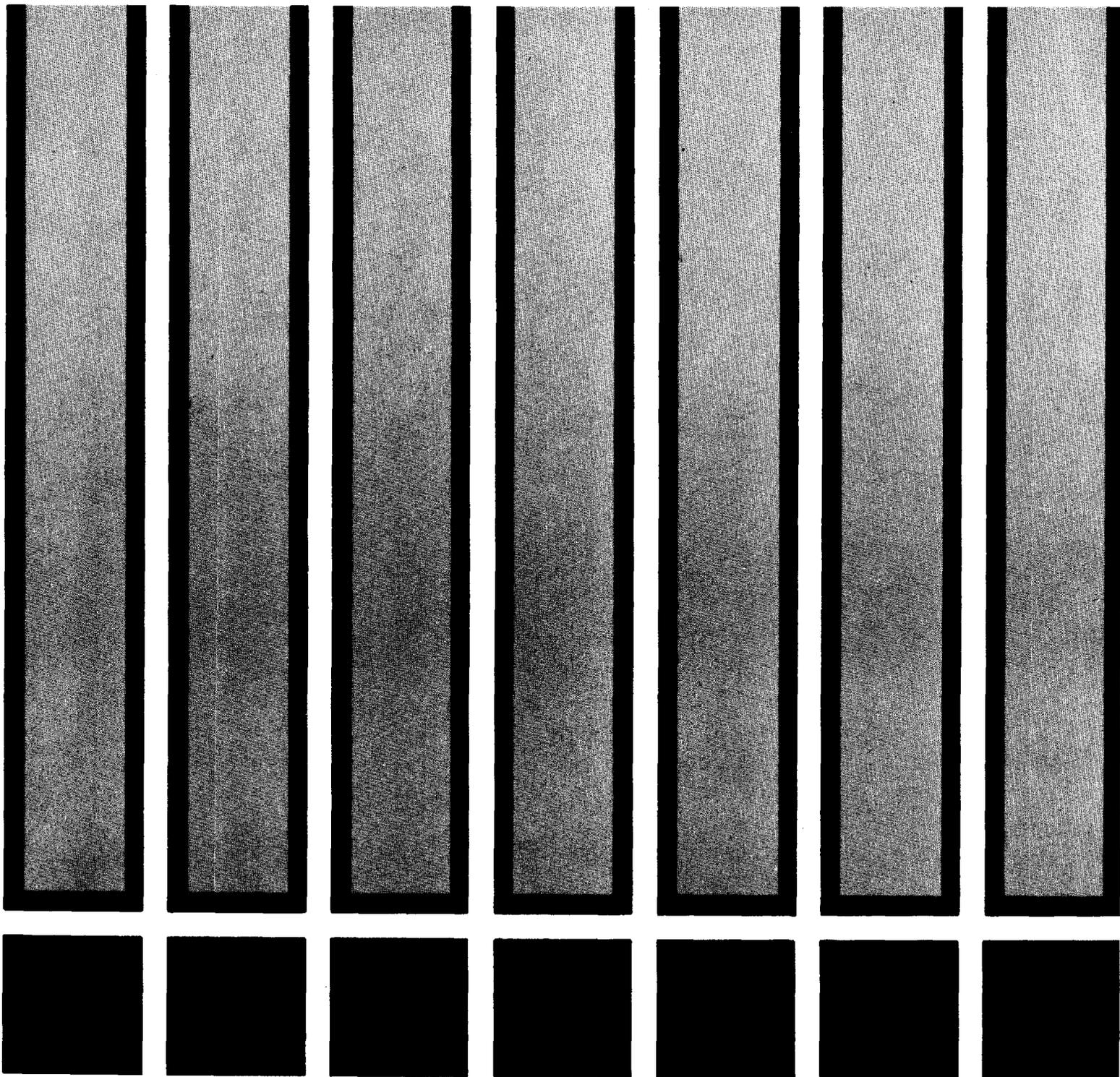


NIOSH

**criteria for a recommended standard
occupational exposure to**

**DECOMPOSITION PRODUCTS of
FLUOROCARBON POLYMERS**



criteria for a recommended standard....

**OCCUPATIONAL EXPOSURE
TO
DECOMPOSITION PRODUCTS of
FLUOROCARBON POLYMERS**



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health
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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 the decomposition products of fluorocarbon polymers by members of the NIOSH staff and the valuable constructive comments by the Review Consultants on the Decomposition Products of Fluorocarbon Polymers 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 who reviewed this criteria document on the decomposition products of fluorocarbon polymers. A list of Review Consultants appears on page vi.

A handwritten signature in black ink that reads "John F. Finklea, M.D." The signature is written in a cursive style with a large, prominent initial 'J'.

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Director, National Institute for
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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 the decomposition products of fluorocarbon polymers. Gerald L. Weiss, Ph.D., of this Division served as criteria manager during the early part of the development of this document, and Jack E. McCracken, Ph.D., served in this capacity during the later phases of its development. SRI International developed the basic information for consideration by NIOSH staff and consultants under contract CDC-99-74-31.

The Division review of this document was provided by J. Henry Wills, Ph.D. (Chairman), Jon R. May, Ph.D., and Robert L. Roudabush, 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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CRITERIA DOCUMENT:
RECOMMENDATIONS FOR AN OCCUPATIONAL EXPOSURE STANDARD
FOR THE DECOMPOSITION PRODUCTS OF FLUOROCARBON POLYMERS

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I. RECOMMENDATIONS FOR A STANDARD FOR THE DECOMPOSITION PRODUCTS
OF FLUOROCARBON POLYMERS

The National Institute for Occupational Safety and Health (NIOSH) recommends that exposure to the decomposition products of fluorocarbon polymers 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 work shift, 40-hour workweek, over a working lifetime. The recommended standard for the decomposition products of fluorocarbon polymers emphasizes good work practices and engineering controls and medical management. Since no measurable environmental level of any single decomposition product of fluorocarbon polymers can ensure complete protection of worker health, no occupational exposure limit is recommended in this document. The criteria and standard will be subject to review and revision as necessary.

Fluorocarbon polymers include polymers of substituted polyethylene monomers of the general formula $(XCX-XCF)_n$, where X can be F, H, Cl, CF₃, or CF₃-CF₂-CF₂-O. The decomposition products of fluorocarbon polymers are defined as substances which are thermally generated from fluorocarbon polymers.

The greatest danger to workers exposed to the decomposition products of fluorocarbon polymers is from inhalation. Adverse effects could result from exposure to dusts of undecomposed fluorocarbon polymers, from exposure to the decomposition products, or from exposure to a single or several

decomposition products. The major concern in occupational exposure to the decomposition products of fluorocarbon polymers is their potential for causing polymer fume fever and damage to the respiratory tract. Polymer fume fever is characterized by headache, aching joints, general malaise, cough, shivering, chills, fever, tachycardia, and possible chest discomfort. The temperature may rise as high as 39.6 C (103.3 F). Adherence to all provisions of the recommended standard is required in work areas in which fluorocarbon polymers are used, regardless of the concentration of airborne decomposition products of fluorocarbon polymers.

Occupational exposure is defined as any exposure to fluorocarbon polymers that may involve the production of decomposition products.

The products liberated from fluorocarbon polymers by the application of heat vary with the polymer, the temperature to which it is exposed, and the humidity of the ambient air. Because there is insufficient information on which to establish a safe workplace environmental concentration, none is recommended. Both employers and employees should take all steps possible to keep occupational exposure to the decomposition products of fluorocarbon polymers as near to zero as possible. Careful adherence to all sections of this recommended standard will facilitate accomplishment of this aim.

Since the decomposition of fluorocarbon polymers can lead to occupational exposure to inorganic fluorides, including hydrogen fluoride, workroom air shall be monitored for inorganic fluorides and hydrogen fluoride in accordance with the requirements of the recommended standards for these substances. Recommended methods for sampling and analysis of workroom air for inorganic fluorides are given in Criteria for a

Recommended Standard....Occupational Exposure to Inorganic Fluorides.
Recommended methods for sampling and analysis of workroom air for hydrogen fluoride are given in Criteria for a Recommended Standard....Occupational Exposure to Hydrogen Fluoride. Adherence to the recommended standards for inorganic fluorides and hydrogen fluoride may not protect the worker from adverse effects caused by other decomposition products of fluorocarbon polymers.

Section 1 - Medical

Medical surveillance should be made available as outlined below to workers occupationally exposed to the decomposition products of fluorocarbon polymers:

(a) Preplacement examinations should include medical and occupational histories and a physical examination with particular attention to the respiratory system.

(b) Periodic examinations may be given at the discretion of the responsible physician.

(c) A judgment of the worker's ability to wear negative and positive pressure respirators should be made.

(d) Appropriate medical management shall be made available to those workers who suffer adverse effects from exposure to the decomposition products of fluorocarbon polymers.

(e) Pertinent medical records of any examinations carried out should be retained for 30 years after termination of employment and should

be made available to the designated medical representatives of the Secretary of Health, Education, and Welfare, of the Secretary of Labor, of the employer, and of the employee or former employee.

Section 2 - Labeling and Posting

All labels and warning signs shall be printed both in English and in the language of the majority 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) Containers of fluorocarbon polymers shall be labelled in a readily visible location as follows:

CAUTION
FLUOROCARBON POLYMER

NO SMOKING!

AT PROCESSING TEMPERATURES, VAPORS MAY BE HARMFUL

Use only with adequate ventilation.
Handle and use only at temperatures recommended for this material
by manufacturers.

First Aid: Remove victim to fresh air and call a physician.

(b) The following sign shall be posted in readily visible locations in any work area where there is occupational exposure to the decomposition products of fluorocarbon polymers:

CAUTION
FLUOROCARBON POLYMER AREA

NO SMOKING!

AT PROCESSING TEMPERATURES, VAPORS MAY BE HARMFUL

Use only with adequate ventilation.
Handle and use only at temperatures recommended for this material.

First Aid: Remove victim to fresh air and call a physician.

Section 3 - Work Clothing and Personal Protective Equipment

Engineering controls shall be used where necessary to minimize the concentration of decomposition products of fluorocarbon polymers in the workplace. Controls which may be appropriate include isolation of a process within a controlled ventilation area, installation of safeguards to prevent thermal excursions, and installation of redundant temperature monitoring systems and associated alarms.

(a) Coveralls, or equivalent clothing, and gloves should be worn by the employee in areas where bulk fluorocarbon polymer dust is handled or where contact of powdered polymer with the skin is likely.

(b) Respiratory protective equipment to be used, if necessary, during emergencies or during the performance of nonroutine maintenance or repair activities in which exposure to the decomposition products of fluorocarbon polymers is likely should be provided in accordance with Table I-1. Applicable regulations for the use of respirators are found in 29 CFR 1910.134.

(c) When a respirator is required by paragraph (b) of this section, it shall be selected and used in accordance with Table I-1 and shall be approved by NIOSH or the Mining Enforcement and Safety Administration (previously by the Bureau of Mines) as specified under the provisions of 30 CFR 11. The employer shall ensure that respirators are adequately cleaned and maintained, and that employees are instructed in the proper use and testing for leakage of respirators assigned to them. Respirators shall be easily accessible, and employees shall be informed of their locations.

TABLE I-1

RESPIRATOR SELECTION GUIDE
FOR DECOMPOSITION PRODUCTS OF FLUOROCARBON POLYMERS

Condition	Respirator Type Approved under Provisions of 30 CFR 11
<u>Maintenance</u> (Miscellaneous; 4-hour limit)	(1) Half-mask respirator equipped with combination acid-gas/organic-vapor sorbent and high-efficiency filter cartridge (2) Full-facepiece gas mask equipped with acid-gas/organic-vapor sorbent and high-efficiency filter canister, changed every 4 hours
<u>Maintenance</u> (Equipment breakdown or cleaning of distillation vessels, etc; no time limit)	Type C supplied-air respirator operated in demand, pressure-demand, or continuous-flow mode and equipped with full facepiece, hood, helmet, or suit
<u>Firefighting</u>	Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode

Section 4 - Informing Employees of Hazards

At the beginning of employment in a fluorocarbon polymer area and at appropriate intervals thereafter, workers shall be informed of the hazards and the proper conditions and precautions for safe handling and use of fluorocarbon polymers. Employees shall be specifically informed of the potential hazards from smoking in a fluorocarbon polymer area and of the characteristics of polymer fume fever. Maintenance and repair workers shall be included in these training programs. Circumstances under which decomposition products of fluorocarbon polymers may be generated shall be particularly emphasized.

The employer shall institute a continuing education program, conducted by persons qualified by experience or training, to ensure that all employees have current knowledge of job hazards, proper maintenance and cleanup methods, and proper respirator use. The information shall be kept on file and be readily accessible to employees at all places of employment where fluorocarbon polymer decomposition products may be encountered. Information shall be recorded on the "Material Safety Data Sheet," shown in the Appendix, or on a similar form approved by the Occupational Safety and Health Administration, US Department of Labor.

Section 5 - Work Practices and Engineering Controls

(a) A no-smoking rule shall be strictly enforced in all areas where there is occupational exposure to the decomposition products of fluorocarbon polymers. As a further precaution, the carrying of smoking

materials into such areas shall be prohibited. Employees shall be instructed to wash their hands before smoking.

(b) In sintering or molding operations where fluorocarbon polymer is heated above its melting point, temperatures in excess of the manufacturers' recommended range should be avoided whenever possible. To prevent overheating, ovens shall be fitted with an automatic temperature cutout set at the manufacturers' recommended temperature for the fluorocarbon polymer.

(c) If necessary to prevent accumulation or recirculation of the decomposition products of fluorocarbon polymers in the workplace, ovens shall be fitted with a local exhaust ventilation system. An appropriate alarm shall be incorporated into any exhaust system in case of its failure.

(d) Local exhaust ventilation, located as close as possible to the operation, shall be used whenever welding, cutting, or related high-temperature operations are performed.

(e) Exhaust systems and ductwork shall be kept in good repair so that design airflows and pressures are maintained. Airflow and pressure should be measured at least twice a year. Continuous airflow indicators (oil or water manometers) are recommended. A log shall be kept showing design airflow or pressure and the results of periodic inspection.

(f) Ventilation systems discharging to outside air must be designed to conform to applicable local, state, and federal air pollution regulations and must not constitute a hazard to employees or to the general population.

(g) General Housekeeping

(1) Spills of fluorocarbon polymers shall be cleaned up, preferably by vacuuming. Care shall be taken that polymer dust is not blown onto steampipes or other heated equipment.

(2) Emphasis shall be placed on prompt and frequent cleanup of dust to prevent accumulation of fluorocarbon polymers.

(3) Equipment shall be maintained regularly, and necessary repairs shall be made promptly.

(4) Fluorocarbon polymer scrap and waste shall be collected in special containers and, if not reused, shall be disposed of by high temperature incineration or by burying.

Section 6 - Sanitation

(a) Smoking shall be prohibited in all areas where fluorocarbon polymers are handled and used, and smoking materials shall not be carried into such areas.

(b) The employer shall provide hand-washing facilities with soap and clean towels. Employees who work in fluorocarbon polymer areas shall be instructed to wash their hands thoroughly before eating, smoking, or handling smoking materials.

(c) In the interest of good industrial safety and hygiene practices, preparation and consumption of food in areas where fluorocarbon polymers in bulk are handled and used should be discouraged. Employers may designate specific areas for these activities.

(d) Where excessive contamination of clothing with fluorocarbon polymer dust is likely, employers shall provide employees with launderable clothing for repeated use or disposable outer garments for one-time use.

(e) Laundry personnel should be informed of the hazards and of safe procedures if they are likely to encounter clothing contaminated with fluorocarbon polymers.

II. INTRODUCTION

This report presents the criteria and the recommended standard that were prepared to meet the need for preventing occupational disease or injury arising from exposure to the decomposition products of fluorocarbon polymers. 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. Criteria and recommended standards should enable management and labor to develop better engineering controls and more healthful work practices. Simply complying with the recommended standard should not be the final goal.

These criteria for a recommended standard for the decomposition products of fluorocarbon polymers have been developed as part of a continuing series of documents published by NIOSH. The proposed standard applies to workplace exposure to the decomposition products of fluorocarbon polymers where these substances are processed, manufactured, or used as applicable under the Occupational Safety and Health Act of 1970. The

standard was not designed for the population-at-large, and any extension to environments other than the occupational one is not warranted. It is intended to (1) protect against development of deleterious effects on health and (2) be attainable with existing technology.

To permit adequate evaluation and control of occupational exposure to the decomposition products of fluorocarbon polymers, additional research is needed in several areas. Epidemiologic studies and investigations of possible carcinogenic, mutagenic, teratogenic, and reproductive effects from the decomposition products of fluorocarbon polymers should be performed. More studies, especially animal toxicity experiments, on the composition and toxicity of these substances are also needed. Most important, further research is required on sampling and analytical methods which would monitor the extent of decomposition of fluorocarbon polymers and permit evaluation of worker exposures.