

criteria for a recommended standard....

**OCCUPATIONAL EXPOSURE
TO
HYDROGEN CYANIDE
and
CYANIDE SALTS
(NaCN, KCN, and Ca(CN)₂)**



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

Center for Disease Control

National Institute for Occupational Safety and Health

OCTOBER 1976

DHEW (NIOSH) Publication No. 77-108

CONTENTS

	<u>Page</u>
PREFACE	v
REVIEW COMMITTEES	viii
I. RECOMMENDATIONS FOR CYANIDE STANDARDS	1
Section 1 - Environmental (Workplace Air)	2
Section 2 - Medical	3
Section 3 - Labeling (Posting)	5
Section 4 - Personal Protective Equipment and Clothing	10
Section 5 - Informing Employees of Hazards of HCN and Cyanide Salts	17
Section 6 - Work Practices and Control Procedures	18
Section 7 - Sanitation Facilities	31
Section 8 - Monitoring and Recordkeeping Requirements	31
II. INTRODUCTION	35
III. BIOLOGIC EFFECTS OF EXPOSURE	37
Substances Presenting Exposure	37
Occurrence and Use	37
Extent of Exposure	41
Historical Reports	41
Metabolism and Theoretical Considerations	45
Effects on Humans	49
Epidemiologic Studies	66
Animal Toxicity	70
Correlation of Exposure and Effect	86
Carcinogenicity, Mutagenicity, and Teratogenicity	94
IV. ENVIRONMENTAL DATA	96
Sampling and Analytical Methods	96
Continuous Monitoring of HCN in Air	103
Control of Exposure	104
V. DEVELOPMENT OF STANDARD	106
Basis for Previous Standards	106
Basis for the Recommended Environmental Standards	107
VI. WORK PRACTICES	115

CONTENTS

VII.	RESEARCH NEEDS	124
VIII.	REFERENCES	126
IX.	APPENDIX I - Methods for Sampling Cyanides in Air and Calibration	147
X.	APPENDIX II - Method for Analysis of Cyanide Samples	151
XI.	APPENDIX III - Hydrogen Cyanide Monitors	157
XII.	APPENDIX IV - Material Safety Data Sheet	160
XIII.	APPENDIX V - First-Aid and Treatment Kits	170
XIV.	TABLES AND FIGURE	174

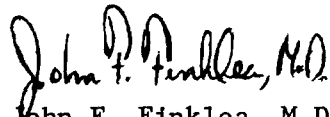
PREFACE

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 hydrogen cyanide and the cyanide salts by members of NIOSH staff and the valuable constructive comments by the Review Consultants, by the ad hoc committee of the the American Medical Association, by Robert B. O'Connor, M.D., NIOSH consultant in occupational medicine, and by Edwin C. Hyatt on respiratory protection. The NIOSH recommendations for standards are not necessarily a consensus of all the consultants and the professional society

that reviewed this criteria document on hydrogen cyanide and cyanide salts.
Lists of the NIOSH Review Committee members and of the Review Consultants
appear on the following pages.

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

John F. Finklea, M.D.
Director, National Institute for
Occupational Safety and Health

The Division of Criteria Documentation and Standards Development, National Institute for Occupational Safety and Health, had primary responsibility for development of the criteria and recommended standards for hydrogen cyanide and the cyanide salts. The Division Review staff for this cyanide document consisted of J. Henry Wills, Ph.D., (chairman), Frank L. Mitchell, D.O., and Bert J. Vos, Ph.D., M.D., (consultant).

The University of Michigan developed the basic information for consideration by NIOSH staff and consultants under contract No. HSM-99-73-31. Alfred N. Milbert, Ph.D., had NIOSH program responsibility and served as criteria manager.

REVIEW COMMITTEE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

John F. Bester, Ph.D.
Office of Extramural Coordination
and Special Projects

Bobby J. Gunter, Ph.D.
Division of Prevention
Region VIII

Robert N. Ligo, M.D.
Division of Surveillance, Hazard Evaluations,
and Field Studies

Lester D. Scheel, Ph.D.
Division of Laboratories and Criteria Development

Department of Labor Liaison:

David Lee
Office of Standards

NIOSH REVIEW CONSULTANTS ON HYDROGEN CYANIDE

Carl D. Bohl, D.Sc.
Monsanto Company
St. Louis, Missouri 63166

Robert M. Clyne, M.D.
Corporate Medical Director
American Cyanamid Company
Wayne, New Jersey 07470

James F. Morgan
Haskell Laboratory
E. I. DuPont de Nemours & Company
Wilmington, Delaware 19898

James H. Sterner, M.D.
Professor, Environmental Occupational Health
The University of Texas
Health Science Center at Houston
School of Public Health
Houston, Texas 77025

Grant S. Winn, Ph.D.
Chief, Air Quality Section
Utah State Division of Health
Salt Lake City, Utah 84113

NIOSH REVIEW CONSULTANTS ON CYANIDE SALTS

William J. Andresen, Director
Occupational Environmental Services
American Cyanamid Co.
Wayne, New Jersey 07470

James Dahlgren, M.D.
American Board of Internal Medicine
Los Angeles, California 90019

Ted A. Loomis, M.D., Ph.D.
Professor of Pharmacology and State Toxicologist
School of Medicine
University of Washington
Seattle, Washington 98105

James F. Morgan
Industrial Hygienist
Havertown, Pennsylvania 19083

Leonard D. Pagnotto
Division of Occupational Hygiene
Massachusetts Department of Labor and Industry
Boston, Massachusetts 02116

Edward P. Radford, M.D.
Professor of Environmental Medicine
School of Hygiene and Public Health
Johns Hopkins University
Baltimore, Maryland 21205