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# **CRITERIA FOR A RECOMMENDED STANDARD**

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## **Occupational Exposure to Metalworking Fluids**

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health  
Cincinnati, Ohio**

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## FOREWORD

In the Occupational Safety and Health Act of 1970 (Public Law 91-596), Congress declared that its purpose was to assure, insofar as possible, safe and healthful working conditions for every working man and woman and to preserve our human resources. In this Act, the National Institute for Occupational Safety and Health (NIOSH) is charged with recommending occupational safety and health standards and describing exposure concentrations that are safe for various periods of employment—including but not limited to concentrations at which no worker will suffer diminished health, functional capacity, or life expectancy as a result of his or her work experience. By means of criteria documents, NIOSH communicates these recommended standards to regulatory agencies (including the Occupational Safety and Health Administration [OSHA]) and to others in the occupational safety and health community.

Criteria documents provide the scientific basis for new occupational safety and health standards. These documents generally contain a critical review of the scientific and technical information available on the prevalence of hazards, the existence of safety and health risks, and the adequacy of control methods. In addition to transmitting these documents to the Department of Labor, NIOSH also distributes them to health professionals in academic institutions, industry, organized labor, public interest groups, and other government agencies.

This criteria document reviews available information about the adverse health effects associated with occupational exposure to metalworking fluids (MWFs) and MWF aerosols. Substantial evidence indicates that workers currently exposed to MWF aerosols have an increased risk of nonmalignant respiratory disease and skin diseases. To prevent or greatly reduce the risk of adverse health effects in exposed workers, NIOSH recommends that exposures to MWF aerosols be limited to 0.4 mg/m<sup>3</sup> of air for thoracic particulate mass (or 0.5 mg/m<sup>3</sup> for total particulate mass) as a time-weighted average (TWA) concentration for up to 10 hr/day during a 40-hr workweek. Total particulate mass is an acceptable substitute for thoracic particulate mass until thoracic samplers are widely available. This recommended exposure limit (REL) is based on evaluation of health effects data, sampling and analytical feasibility, and technological feasibility. The NIOSH recommendation for reducing MWF aerosol exposures is supported by substantial evidence associating some MWFs used before the mid-1970s with cancer at several organ sites, and by the potential for current MWFs to pose a similar carcinogenic hazard. However, the primary basis of the NIOSH recommendation is the risk that MWFs pose for nonmalignant respiratory disease.

In addition to the REL, NIOSH recommends that a comprehensive safety and health program be developed and implemented as part of the employer's management system. This program should include safety and health training, worksite analysis, hazard prevention and control, and medical monitoring of exposed workers.

Future research may provide new and more effective methods for minimizing occupational health risks among workers exposed to MWFs. If future developments permit a lower exposure limit that is technologically feasible and prudent for the public health, NIOSH will revise its recommended standard. Until then, adherence to the REL of 0.4 mg/m<sup>3</sup> will minimize the risk that workers exposed to MWFs will suffer adverse health effects.

A handwritten signature in black ink that reads "Linda Rosenstock". The signature is fluid and cursive, with the first name "Linda" being more prominent than the last name "Rosenstock".

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## **ABSTRACT**

**This criteria document reviews available information about the adverse health effects associated with occupational exposure to metalworking fluids (MWFs) and MWF aerosols. Substantial evidence indicates that workers currently exposed to MWF aerosols have an increased risk of nonmalignant respiratory disease and skin diseases. To prevent or greatly reduce the risk of adverse health effects in exposed workers, NIOSH recommends that exposures to MWF aerosols be limited to 0.4 mg/m<sup>3</sup> of air for thoracic particulate mass (or 0.5 mg/m<sup>3</sup> for total particulate mass) as a time-weighted average (TWA) concentration for up to 10 hr/day during a 40-hr workweek. Total particulate mass is an acceptable substitute for thoracic particulate mass until thoracic samplers are widely available. This recommended exposure limit (REL) is based on evaluation of health effects data, sampling and analytical feasibility, and technological feasibility. The NIOSH recommendation for reducing MWF aerosol exposures is supported by substantial evidence associating some MWFs used before the mid-1970s with cancer at several organ sites, and by the potential for current MWFs to pose a similar carcinogenic hazard. However, the primary basis of the NIOSH recommendation is the risk that MWFs pose for nonmalignant respiratory disease.**

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# CONTENTS

Foreword . . . . .	iii
Abstract . . . . .	v
Abbreviations . . . . .	xiii
Acknowledgments . . . . .	xvi

## **1 Recommendation for a Metalworking Fluids Standard . . . . . 1**

1.1 Recommended Exposure Limits. . . . .	1
1.1.1 Exposure . . . . .	1
1.1.2 Safety and Health Program. . . . .	2
1.2 Definitions. . . . .	2
1.2.1 MWF Aerosol . . . . .	2
1.2.2 The Metalworking Environment. . . . .	2
1.2.3 MWF Classes. . . . .	2
1.3 Sampling and Analysis . . . . .	3
1.4 Exposure Monitoring . . . . .	3
1.5 Informing Workers about the Hazards . . . . .	4
1.5.1 Safety and Health Training. . . . .	4
1.5.2 Hazard Prevention and Control . . . . .	4
1.6 Engineering Controls and Work Practices. . . . .	5
1.6.1 MWF Selection . . . . .	5
1.6.2 Fluid Use and Delivery. . . . .	5
1.6.3 Fluid Maintenance . . . . .	5
1.6.4 Ventilation Systems . . . . .	6
1.6.5 Protective Clothing and Equipment . . . . .	7
1.7 Respiratory Protection. . . . .	8
1.8 Sanitation and Hygiene . . . . .	9
1.9 Medical Monitoring . . . . .	9
1.9.1 Supervision of the Medical Monitoring Program. . . . .	10
1.9.2 Initial or Preplacement Examinations. . . . .	10
1.9.3 Periodic Examinations . . . . .	11
1.9.4 Detailed Medical Examinations for Selected Workers . . . . .	11

1.9.5	Physician's Reports to the Worker . . . . .	11
1.9.6	Physician's Reports to the Employer . . . . .	11
1.9.7	Employer Actions . . . . .	12
1.9.8	Followup Medical Evaluations . . . . .	12
1.10	Labeling and Posting . . . . .	12
<b>2</b>	<b>Production, Formulation, Application, and Deterioration . . . . .</b>	<b>13</b>
2.1	Production and Use . . . . .	13
2.2	Formulation . . . . .	14
2.2.1	Straight Oil MWFs . . . . .	14
2.2.2	Soluble Oil MWFs . . . . .	14
2.2.3	Semisynthetic MWFs . . . . .	16
2.2.4	Synthetic MWFs . . . . .	16
2.2.5	MWF Ingredients and Additives . . . . .	17
2.3	MWF Application . . . . .	17
2.4	Deterioration of In-service MWFs . . . . .	17
<b>3</b>	<b>Potential for Occupational Exposures to MWFs . . . . .</b>	<b>21</b>
3.1	The National Occupational Exposure Survey . . . . .	21
3.2	Occupational Exposures to Mineral Oil Mists . . . . .	21
3.3	NIOSH Health Hazard Evaluations . . . . .	23
3.4	Reported Exposures in the Automotive Industry . . . . .	23
<b>4</b>	<b>Selected Potentially Hazardous Chemical Ingredients, Additives, and Contaminants . . . . .</b>	<b>25</b>
4.1	Chemical Ingredients and Additives . . . . .	25
4.1.1	Triethanolamine . . . . .	25
4.1.2	Mineral Oil . . . . .	28
4.1.3	Antimicrobial Agents . . . . .	28
4.1.4	Chlorinated Paraffins . . . . .	31
4.1.5	Potential Sensory or Pulmonary Irritants . . . . .	33
4.2	Hazardous Contaminants . . . . .	34
4.2.1	Nitrosamines . . . . .	35
4.2.1.1	NIOSH Reports of Nitrosamine Contamination . . . . .	36
4.2.1.2	Carcinogenicity of Nitrosamines . . . . .	37

4.2.2	Microbial Contamination . . . . .	37
4.2.2.1	Ecology. . . . .	37
4.2.2.2	Hazards. . . . .	41
4.3	Metals and Metal Alloy Contaminants. . . . .	43

**5 Occupational Health Risks  
for Workers Exposed to MWFs . . . . . 44**

5.1	Nonmalignant Respiratory Effects . . . . .	44
5.1.1	Diseases of the Lung Parenchyma . . . . .	44
5.1.1.1	Lipid Pneumonia . . . . .	44
5.1.1.2	Hard Metal Disease . . . . .	44
5.1.1.3	Legionellosis . . . . .	45
5.1.1.4	HP . . . . .	45
5.1.1.5	Summary . . . . .	47
5.1.2	Asthma and Other Disorders of the Pulmonary Airways. . . . .	47
5.1.2.1	Background . . . . .	47
5.1.2.2	Asthma . . . . .	48
5.1.2.3	Symptoms of Airways Disorders . . . . .	59
5.1.2.4	Cross-Sectional Studies of Lung Function. . . . .	66
5.1.2.5	Cross-Shift Studies of Acute Effects on Lung Function . . . . .	77
5.1.3	Discussion. . . . .	85
5.2	Tumorigenic Effects in Animals . . . . .	86
5.3	Carcinogenic Effects . . . . .	87
5.3.1	Criteria for Inclusion . . . . .	88
5.3.2	Studies of Cancer in Broad Occupational Groups . . . . .	88
5.3.3	Investigations of Selected Cancers . . . . .	89
5.3.3.1	Skin and Scrotal Cancer . . . . .	93
5.3.3.2	Laryngeal Cancer . . . . .	123
5.3.3.3	Rectal Cancer . . . . .	124
5.3.3.4	Pancreatic Cancer . . . . .	125
5.3.3.5	Bladder Cancer . . . . .	127
5.3.3.6	Stomach Cancer . . . . .	129
5.3.3.7	Esophageal Cancer . . . . .	131
5.3.3.8	Other Sites. . . . .	132
5.3.3.9	Brain/Nervous System Cancer . . . . .	132
5.3.3.10	Prostate Cancer . . . . .	132
5.3.3.11	Lung Cancer. . . . .	133



5.3.3.12	Colon Cancer . . . . .	133
5.3.3.13	Hematopoietic and Lymphopoietic Cancer . . . . .	134
5.3.4	Genetic Effects . . . . .	134
5.3.5	Information about Exposure Concentrations . . . . .	135
5.3.6	Route of Exposure . . . . .	136
5.3.7	Conclusion . . . . .	137
5.4	Dermatologic Conditions . . . . .	139
5.4.1	Cutaneous Disorders . . . . .	139
5.4.2	Irritants . . . . .	140
5.4.3	Allergens . . . . .	140
5.4.4	Prognosis and Preventive Measures . . . . .	141
<b>6</b>	<b>Current Occupational Recommendations and Standards . . . . .</b>	<b>143</b>
<b>7</b>	<b>Sampling and Analytical Methods . . . . .</b>	<b>147</b>
7.1	Background of Current Methods . . . . .	147
7.2	Potential Sampling and Analytical Method Bias and Sources of Error in Measuring MWFs . . . . .	149
7.2.1	Sampling According to ACGIH Conventions . . . . .	149
7.2.2	Thoracic Samplers . . . . .	149
7.2.3	Sampler Inlet Biases . . . . .	150
7.2.4	Other Sampler Biases . . . . .	150
7.2.5	Estimating Total Method Bias . . . . .	151
7.2.6	Estimating Total Method Precision . . . . .	151
7.3	Sampling and Analytical Issues Involved in Establishing the Rel . . . . .	153
7.3.1	Loq. . . . .	153
7.3.2	STELs and Ceiling Limits . . . . .	153
<b>8</b>	<b>Basis for the Recommended Standard . . . . .</b>	<b>155</b>
8.1	Introduction . . . . .	155
8.2	Effects of MWF Exposure . . . . .	157
8.2.1	Nonmalignant Respiratory Effects . . . . .	157
8.2.1.1	Asthma and Synthetic MWFs . . . . .	157
8.2.1.2	Asthma and Soluble Oil MWFs . . . . .	158

8.2.1.3	Asthma and Straight Oil MWFs . . . . .	158
8.2.1.4	Respiratory Effects Other Than Asthma . . . . .	159
8.2.1.5	Rationale for Reducing MWF Exposures . . . . .	160
8.2.2	Cancer . . . . .	162
8.2.3	Dermatologic Effects . . . . .	163
8.2.4	Effects of Microbial Contamination . . . . .	165
8.3	Rationale for the REL. . . . .	166
8.3.1	Respiratory Health Effects. . . . .	167
8.3.2	Index for Measuring MWF Exposures . . . . .	167
8.3.3	Applicability of REL to All MWFs . . . . .	169
8.3.4	Technologic Feasibility of Controlling MWF Exposures. . . . .	170
8.4	Summary . . . . .	171

## **9 Recommendations for an Occupational Safety and Health Program . . . . . 173**

9.1	Safety and Health Training . . . . .	173
9.2	Environmental Monitoring . . . . .	173
9.3	Hazard Prevention and Control . . . . .	174
9.3.1	Work Practices. . . . .	175
9.3.1.1	Fluid Selection, Use, and Application . . . . .	175
9.3.1.2	Fluid Maintenance . . . . .	176
9.3.1.3	Sanitation and Hygiene . . . . .	178
9.3.2	Labeling and Posting . . . . .	179
9.3.3	Engineering Controls . . . . .	179
9.3.3.1	Isolation. . . . .	179
9.3.3.2	Ventilation . . . . .	180
9.3.4	Protective Clothing and Equipment . . . . .	181
9.3.4.1	Protective Clothing . . . . .	181
9.3.4.2	Respiratory Protection . . . . .	183
9.4	Medical Monitoring of Exposed Workers . . . . .	184
9.4.1	Information Provided to Program Director . . . . .	186
9.4.2	Initial or Preplacement Examination . . . . .	186
9.4.3	Periodic Examination . . . . .	186
9.4.4	Detailed Medical Examinations for Selected Workers . . . . .	187
9.4.5	Physician's Reports to the Worker. . . . .	188
9.4.6	Physician's Reports to the Employer . . . . .	188

9.4.7 Employer Actions . . . . . 189  
9.4.8 Followup Medical Evaluations . . . . . 189

**10 Research Needs . . . . . 190**

**References . . . . . 192**

## ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
APF	Assigned protection factor
ASTM	American Society for Testing and Materials
Ca	NIOSH potential occupational carcinogen
cc	Cubic centimeter
CFR	<i>Code of Federal Regulations</i>
CI	Confidence interval
CMA	Chemical Manufacturers Association
CPC	Chemical protective clothing
DEA	Diethanolamine
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
°F	Degrees Fahrenheit
Fed. Reg.	<i>Federal Register</i>
FEF	Forced expiratory flow
FEV <sub>1</sub>	Forced expiratory volume in 1 sec
ft	Feet or foot
FVC	Forced vital capacity
HEPA filter	High-efficiency particulate air filter
HHE	Health Hazard Evaluation
HP	Hypersensitivity pneumonitis
Hr	Hour(s)
IARC	International Agency for Research on Cancer
lb	Pound(s)
ILMA	Independent Lubricant Manufacturers Association
IMIS	Integrated Management Information System

<b>ISO</b>	<b>International Standards Organization</b>
<b>L/min</b>	<b>Liters/minute</b>
<b>LOQ</b>	<b>Limit of quantitation</b>
<b>m<sup>3</sup></b>	<b>Cubic meter</b>
<b>MEA</b>	<b>Monoethanolamine</b>
<b>mg</b>	<b>Milligram</b>
<b>min</b>	<b>Minute(s)</b>
<b>ml</b>	<b>Milliliter</b>
<b>MOR</b>	<b>Mortality odds ratio</b>
<b>MSDS</b>	<b>Material safety data sheet</b>
<b>MSHA</b>	<b>Mine Safety and Health Administration</b>
<b>MWF</b>	<b>Metalworking fluid</b>
<b>NCI</b>	<b>National Cancer Institute</b>
<b>NCMS</b>	<b>National Center for Manufacturing Sciences</b>
<b>NDBA</b>	<b>N-nitrosodibutylamine</b>
<b>NDELA</b>	<b>N-nitrosodiethanolamine</b>
<b>NDEA</b>	<b>N-nitrosodiethylamine</b>
<b>NDMA</b>	<b>N-nitrosodimethylamine</b>
<b>ng</b>	<b>Nanogram</b>
<b>NIOSH</b>	<b>National Institute for Occupational Safety and Health</b>
<b>NMOR</b>	<b>N-nitrosomorpholine</b>
<b>NO</b>	<b>Nitrous oxide</b>
<b>NOES</b>	<b>National Occupational Exposure Survey</b>
<b>NTP</b>	<b>National Toxicology Program</b>
<b>OHAB</b>	<b>Occupational Health Advisory Board of the UAW-GM</b>
<b>OR</b>	<b>Odds ratio</b>
<b>OSHA</b>	<b>Occupational Safety and Health Administration</b>
<b>P</b>	<b>Probability</b>
<b>PAH</b>	<b>Polyaromatic hydrocarbons</b>
<b>PEL</b>	<b>Permissible exposure limit</b>

<b>PMR</b>	<b>Proportionate mortality ratio</b>
<b>ppm</b>	<b>Parts per million</b>
<b>psi</b>	<b>Pounds per square inch</b>
<b>PTFE</b>	<b>Polytetrafluoroethylene</b>
<b>RD<sub>50</sub></b>	<b>Exposure concentration resulting in a 50% reduction in respiratory frequency</b>
<b>REL</b>	<b>Recommended exposure limit</b>
<b>RR</b>	<b>Relative risk, rate ratio</b>
<b>RSD</b>	<b>Relative standard deviation</b>
<b>SD</b>	<b>Standard deviation</b>
<b>sec</b>	<b>Second(s)</b>
<b>SENSOR</b>	<b>Sentinel Event Notification System for Occupational Risks</b>
<b>SIC</b>	<b>Standard Industrial Classification</b>
<b>SIR</b>	<b>Standardized incidence ratio</b>
<b>SMR</b>	<b>Standardized mortality ratio</b>
<b>spp.</b>	<b>Species</b>
<b>STEL</b>	<b>Short-term exposure limit</b>
<b>TEA</b>	<b>Triethanolamine</b>
<b>TLV</b>	<b>Threshold limit value</b>
<b>TWA</b>	<b>Time-weighted average</b>
<b>UAW</b>	<b>International Union, United Automobile, Aerospace and Agricultural Implement Workers of America</b>
<b>µg</b>	<b>Microgram</b>
<b>µm</b>	<b>Micrometer</b>

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