# CRITERIA FOR A RECOMMENDED STANDARD

## 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
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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 $mg/m^3$ of air for thoracic particulate mass (or 0.5 $mg/m^3$ 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$^3$ will minimize the risk that workers exposed to MWFs will suffer adverse health effects.

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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 $mg/m^3$ of air for thoracic particulate mass (or 0.5 $mg/m^3$ 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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# 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 | *Code of Federal Regulations* |
| 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. | *Federal Register* |
| FEF | Forced expiratory flow |
| $FEV_1$ | 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 |

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

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

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