



NIOSH

Criteria for a Recommended Standard

Welding, Brazing, and Thermal Cutting

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

CRITERIA FOR A RECOMMENDED STANDARD
Welding, Brazing, and Thermal Cutting

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
DIVISION OF STANDARDS DEVELOPMENT AND TECHNOLOGY TRANSFER**

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FOREWORD

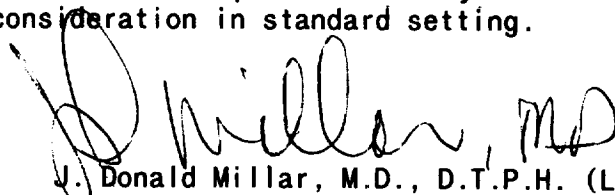
The purpose of the Occupational Safety and Health Act of 1970 (Public Law 91-596) is to ensure safe and healthful working conditions for every working person and to preserve our human resources by providing medical and other criteria that will ensure, insofar as practicable, that no worker will suffer diminished health, functional capacity, or life expectancy as a result of his or her work experience. The Act authorizes the National Institute for Occupational Safety and Health (NIOSH) to develop and recommend occupational safety and health standards and to develop criteria for improving them. By this means, NIOSH communicates these criteria both to regulatory agencies and others in the community of occupational safety and health.

Criteria documents provide the basis for the occupational health and safety standards sought by Congress. 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. NIOSH distributes these documents to health professionals in academia, industry, organized labor, public interest groups, and other appropriate government agencies.

This criteria document on welding, brazing, and thermal cutting reviews available information on the health risks for workers in these occupations and provides criteria for eliminating or minimizing the occupational risks these workers may encounter. Evidence from epidemiologic studies and case reports of workers exposed to welding emissions clearly establishes the risk of acute and chronic respiratory disease. The major concern, however, is the excessive incidence of lung cancer among welders. A large body of evidence from regional occupational mortality data, case control studies, and cohort studies indicates that welders generally have a 40% increase in relative risk of developing lung cancer as a result of their work experiences. The basis of this excess risk is difficult to determine given uncertainties about smoking habits, possible interactions among the various components of welding emissions, and possible exposures to other occupational carcinogens, including asbestos. The severity and prevalence of other respiratory conditions such as chronic bronchitis, pneumonia, and decrements in pulmonary function are not well characterized among welders, but these effects have been observed in both smoking and nonsmoking workers in this occupation. Excesses in morbidity and mortality among welders appear to exist even when exposures have been reported to be below current Occupational Safety and Health Administration (OSHA) permissible exposure limits (PELs) for the many individual components of welding emissions.

An exposure limit for total welding emissions cannot be established because the composition of welding fumes and gases varies for different welding processes and because the various components of the emissions may interact to produce adverse health effects. NIOSH therefore recommends that exposures to all welding emissions be reduced to the lowest feasible concentrations using state-of-the-art engineering controls and work practices. Exposure limits for individual chemical or physical agents are to be considered upper boundaries of exposure. Presently it is not possible to associate a particular health hazard with a specific component of total welding emissions; however, the risk of lung cancer for workers who weld on stainless steel appears to be associated with exposure to fumes that contain nickel and chromium. NIOSH has previously recommended to OSHA that exposures to specific forms of these metals be treated as exposures to occupational carcinogens. Future research may make it possible to differentiate risks associated with a particular exposure. NIOSH will evaluate such data as they become available and revise this recommended standard as appropriate.

The Institute takes sole responsibility for the conclusions and recommendations presented in this document. All reviewers' comments are being sent with this document to the Occupational Safety and Health Administration (OSHA) for consideration in standard setting.



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ABSTRACT

This document examines the occupational health risks associated with welding, brazing, and thermal cutting, and it provides criteria for eliminating or minimizing the risks encountered by workers in these occupations. The main health concerns are increased risks of lung cancer and acute or chronic respiratory disease.

The data in this document indicate that welders have a 40% increase in relative risk of developing lung cancer as a result of their work experience. The basis for this excess risk is difficult to determine because of uncertainties about smoking habits, possible interactions among the various components of welding emissions, and possible exposures to other occupational carcinogens. However, the risk of lung cancer for workers who weld on stainless steel appears to be associated with exposure to fumes that contain nickel and chromium.

The severity and prevalence of noncarcinogenic respiratory conditions are not well characterized among welders, but they have been observed in both smoking and nonsmoking workers in occupations associated with welding. Excesses in morbidity and mortality among welders exist even when reported exposures are below current Occupational Safety and Health Administration (OSHA) permissible exposure limits (PELs) for the many individual components of welding emissions.

An exposure limit for total welding emissions cannot be established because the composition of welding fumes and gases varies for different welding processes and because the various components of a welding emission may interact to produce adverse health effects. NIOSH therefore recommends that exposures to all welding emissions be reduced to the lowest feasible concentrations using state-of-the-art engineering controls and work practices. Exposure limits for individual chemical or physical agents are to be considered upper boundaries of exposure.

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ABBREVIATIONS

A	--Ampere
ACGIH	--American Conference of Governmental Industrial Hygienists
ANSI	--American National Standards Institute
API	--American Petroleum Institute
AWS	--American Welding Society
CDLSR	--California Division of Labor and Research
cfm	--cubic feet per minute
CI	--confidence interval
cm	--centimeter
CO	--carbon monoxide
CO ₂	--carbon dioxide
db	--decibels
dBA	--decibel(s) measured on the A scale
DMSO	--dimethylsulfoxide
fpm	--feet per minute
ft	--foot
hr	--hour
in.	--inch
ILO	--International Labour Office
IR	--infrared
kW	--kilowatt
m	--meter
mg	--milligram
MHz	--megahertz
min	--minute
mm	--millimeters
MnO	--manganese oxide
mppcf	--millions of particles per cubic foot
NFPA	--National Fire Protection Association
NIOSH	--National Institute for Occupational Safety and Health
NO ₂	--nitrogen dioxide
N ₂ O	--nitrous oxide
nm	--nanometer
OR	--odds ratio
OSHA	--Occupational Safety and Health Administration
PEL	--permissible exposure limit
PFT	--pulmonary function test
PMR	--proportional mortality ratio
ppm	--parts per million
REL	--recommended exposure limit
RF	--radiofrequency
SCE	--sister chromatid exchange
sec	--second
SiO ₂	--silicon dioxide

SMR	--standard mortality ratio
SPF	--sun protection factor
TiO ₂	--titanium dioxide
TLV®	--threshold limit value
TWA	--time-weighted average
UV	--ultraviolet

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