

Effects of Welding on Health, III



American Welding Society



Documents

Document Sharing Hub

Effects of Welding on Health III

An up-dated (June 1979-December 1980) literature survey and evaluation of the data recorded since the publication of the first report, to understand and improve the occupational health of welding personnel.

Research performed by the Franklin Institute under contract with the American Welding Society and supported by industry contributions.

**By
Samir Zakhari
and
John Strange**

**Franklin Institute Research Laboratory, Inc.
A Subsidiary of the Franklin Institute
The Benjamin Franklin Parkway
Philadelphia, PA 19103**

Prepared for:
**SAFETY AND HEALTH COMMITTEE
AMERICAN WELDING SOCIETY**
P.O. Box 351040
Miami, Florida 33135

International Standard Book Number: 0-87171-226-1
Library of Congress Number: 79-52672

American Welding Society, 550 LeJeune Road, Miami, FL 33126

©1983 by American Welding Society.
All rights reserved.

This report is published as a service and convenience to the welding industry and is the product of an independent contractor (Franklin Institute Research Laboratory) which is solely responsible for its contents. The materials in this report have not been independently reviewed or verified and are only offered as information. AWS assumes no responsibility for any claims that may arise from the use of this information. Users must make independent investigations to determine the applicability of this information for their purposes.

Printed in the United States of America



Contents

<i>Personnel</i>	v
<i>Acknowledgements</i>	vii
<i>Preface</i>	ix
<i>Introduction</i>	xi
<i>Technical Summary</i>	xiii
1. <i>The Exposure</i>	1
1.1 Fumes	1
1.2 Gases	4
1.3 Radiation	4
1.4 Noise	5
2. <i>Effects of Welding on Human Health</i>	5
2.1 Toxicity to Various Organs	5
2.2 Mutagenicity of Carcinogenicity of the Fumes and Gases	15
2.3 Epidemiologic Studies	16
3. <i>Toxicologic Investigations in Animals</i>	16
4. <i>In Vitro Studies</i>	18
5. <i>Conclusions and Recommendations</i>	19
<i>References</i>	21

Personnel

Authors of the report by Franklin Research Center were:

Samir Zakhari and John Strange

AWS Research Committee

<i>A.N. Ward, Chairman</i>	Caterpillar Tractor Company
<i>K.L. Brown, Vice Chairman</i>	Lincoln Electric Company
<i>M.E. Kennebeck, Jr., Secretary</i>	American Welding Society
<i>J.S. Gorski</i>	Kemper Insurance Companies
<i>E. Mastromatteo</i>	INCO Limited

Acknowledgements

The American Welding Society gratefully acknowledges the time and effort expended by the members of the Research Committee and the financial support of the program by industry contributions.

Supporting Organizations

Air Products and Chemicals, Inc.
Airco Welding Products
Allis-Chalmers
Alloy Rods Division, The Chemetron Corporation
AWS Detroit Section
AWS New Orleans Section
Arcos Corporation
The Binkley Company
Caterpillar Tractor Company
Chicago Bridge and Iron Company
Grove Manufacturing Company, Division of Kidde, Inc.
General Electric Company
The Heil Company
Hobart Brothers Company
Huntington Alloys, Inc.
Lincoln Electric Company
Miller Electric Manufacturing Company
National-Standard Company
A.O. Smith Corporation
Teledyne-McKay, Inc.
Trinity Industries, Inc.
Truck Trailer Manufacturers Association
Walker Stainless Equipment Company
Weld Tooling Corporation

Many other organizations have made contributions to support the ongoing program from May 1979 to the present.

Preface

This literature review has been prepared for the Safety and Health Committee of the American Welding Society to provide an assessment of current knowledge of the effects of welding on health, as well as to aid in the formulation of a research program in this area, as part of an ongoing program sponsored by the Committee. Previous work has included studies of fumes and gases, radiation, and noise generated during various forms of arc welding. Conclusions based on this review and recommendations for further research are presented in Section 5 of the report. Section 1 summarizes the occupational exposures. Sections 2 and 3 contain information related to the effects of exposure to byproducts of welding operations on humans and laboratory animals. Section 4 covers *in vitro* studies.

Referenced materials are available from the Franklin Institute.

Introduction

The American Welding Society (AWS) has been concerned about the possible health hazards due to the exposure of welders to fumes, gases, radiation, and noise from various welding processes. Although much has already been learned about welding processes and technology, the effects of welding on human health have not been fully understood.

To help the studying and understanding of the welding environment and its effects on health, the AWS has undertaken a literature review entitled "Effects of Welding on Health" that was published in 1979, and has been updated to cover the period of January 1978 to May 1979.

Since then, interest in studying the effects of the welding environment on the various physiological

systems has continued and many articles have appeared in the published literature. The present effort represents a continuation of assessing the effects of welding on health and presents an update to include information published from June 1979 to December 1980.

The reader is cautioned that the papers reviewed were examined only for consistency. No independent checks of the experiments or findings were performed. This report must be read in conjunction with "Effects of Welding on Health" by Villaume et al., and the update by Zakhari and Anderson (Vol II). References are listed at the end in alphabetical order based upon first author.

Technical Summary

The objective of this report is to evaluate and present the state-of-knowledge of the effects of welding on health, to point out gaps in this knowledge, and to provide recommendations to the American Welding Society for future studies. This report covers the period of June 1979 to December 1980, and must be read in conjunction with the previous literature review (Villaume et al. 1978) and the update which covers the period January 1978 to May 1979 (Zakhari and Anderson, 1981).

This report, as is the case of the previous two reports, is divided into 4 sections entitled: 1) The Exposure, 2) Effects of Welding on Human Health, 3) Toxicologic Investigations in Animals, and 4) In Vitro Studies.

The Exposure

In this chapter, studies performed on welding fumes, gases, radiation, and noise are summarized.

Fumes

During welding, particulate matter is generated from the base metal, welding rod, the flux, any coatings or contaminants of the metal surface, or any combination of these. The rate of fume generation and the composition and particle size distribution of the fumes vary according to the metal being welded and the welding method used. The components that are of special concern to welders include silicon compounds, chromium, nickel, fluoride, copper and manganese. Because of the potential health hazard of hexavalent chromium to man, several efforts have been made

either to minimize the amounts of chromium in welding fumes, or to develop sensitive methods of continuously monitoring its concentrations in the ambient atmosphere of welders and in their biological fluids.

Potential health hazards from welding fumes are determined not only by the composition of the fumes and their concentration in air, but also by the duration of exposure as well as the particle size distribution. Fortunately, these hazards can be overcome by the use of appropriate protective devices and by engineering controls.

Gases

Contrary to the common belief that ozone is found in high concentrations in the vicinity of welding areas, studies conducted by Press (1978) revealed that very low concentrations of ozone are formed during plasma arc cutting. These low concentrations were ascribed to the reaction of ozone with nitrous oxide and the disintegration of ozone due to the presence of dust particles.

Radiation

Welding produces electromagnetic radiation that can be divided into visible, ultraviolet, and infrared. Radiation of wavelength shorter than 175 nm are rarely encountered during welding due to their absorption by atmospheric oxygen (Lunau, 1967). The use of thoriated tungsten welding electrodes (GTAW process) could result in the exposure to thorium and daughters contained in these electrodes. The magnitude of the radiation to which welders may be exposed was estimated to be between 20 millirem and one rem.