Fumes and Gases in the Welding Environment

A Research Report on Fumes and Gases Generated During Welding Operations

Research performed at Battelle-Columbus Laboratories under contract with the American Welding Society and supported by industry contributions

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Abstract

The environment surrounding many welding processes contains fumes (particulate matter) that may be harmful (toxic) or relatively harmless and gases that may have pulmonary or non-pulmonary effects. This report summarizes five experimental studies and several literature surveys (conducted by Battelle Memorial Institute-Columbus Laboratories for the American Welding Society) to evaluate the extent to which ventilation may control the exposure of the welder to these fumes and gases and to investigate the nature of the various fumes and gases generated in arc welding, in brazing with silver-based filler metals, in thermal spraying, and in oxyfuel gas cutting.

Comprehensive fume control requires exhaust flow rates adequate to reduce room contamination below critical levels, or cross-draft ventilation (or air-ventilated helmets) to remove fumes from the welder's breathing zone, or sometimes both.

Tables in this report show what fumes and gases are generated by fourteen types of covered electrodes for shielded metal arc welding, seven electrodes for flux cored arc welding, eleven gas metal arc solid electrodes, two BAg-class brazing filler metals, seven spraying and surfacing metals, and three thicknesses of carbon steel plate severed by oxyacetylene and oxymethane cutting under various operating conditions.

These data can be used in part to determine blower capacity and exhaust flow rates needed for ventilation.

Introduction

The American Welding Society has sponsored a two-year program, entitled "Improving the Welding Environment," conducted by Battelle's Columbus Laboratories. This book is a report of that research and consolidates the content of five topical reports on the program.

Overview of Fume Constituents

Fumes are particles formed by electrode (and base metal) constituents that are vaporized and subsequently condensed in the welding area. Because of their small size, fume particles may remain suspended in the aerosol form for long periods. Since the particles have mass and size and are affected by air movement, electrical fields, gravity, diffusional forces, and other external forces, they tend to agglomerate into clumps that gradually settle on the floor and other surfaces. While suspended, however, they are inhaled by all persons in the vicinity.

In addition to fume particles, there are also gases formed that have toxic effects. These include ozone, oxides of nitrogen, and carbon monoxide.

The presence of fumes and gases in the welding environment is a matter of concern to those responsible for the well-being of welding personnel. Some constitute a potential hazard to the health of the welder while others are merely a nuisance. Potential problems can be anticipated by estimating the concentrations of fume and gas.