

WELDING AND CUTTING

Personal Protection

Respiratory protection

During welding and cutting operations, toxic gases, fumes, and dusts may be evolved, depending on the type of electrode used, the base metal being welded or cut, and whether or not the base metal is coated with such materials as tar, paint, lead, or zinc. Gases—the oxides of nitrogen, carbon monoxide, ozone—and metallic dusts and fumes may, in varying degree, present inhalation hazards if adequate respiratory protection is not provided.

American Standard Z49.1, *Safety in Welding and Cutting*, gives specifications for local exhaust systems, general ventilation, and health protection of workers on various types of welding and cutting. The following discussion is based on this standard, which should be consulted for further information.

In *open-air welding or cutting* or in large, well-ventilated areas, where clean carbon steel is welded or cut with bare or coated carbon-steel electrodes and without inert-gas shielding, no health hazard exists.

In *confined areas*, such as tanks, pressure vessels, and holds of ships, local exhaust or general ventilation systems should be provided to maintain concentrations of toxic gases, fumes, or dusts below maximum allowable concentrations (MAC) as defined in American Standard Z37 or below threshold limit values (TLV) specified by the American Conference of Governmental Industrial Hygienists. If gases, dusts, and fumes cannot be kept below the MAC or TLV because work is intermittent or for other reasons, welders should wear respiratory protective equipment approved for the exposure by the U.S. Bureau of Mines. Where oxygen is also deficient, self-contained breathing apparatus or hose masks with blowers are necessary.

Coatings, fluxes, and base metals When welding or cutting involves coatings or fluxes containing base metals that contain elements such as zinc, fluorine, beryllium, lead, or cadmium, and their compounds, local exhaust removal or general ventilation should be provided to maintain the concentration of any toxic gases generated below the MAC or TLV. Outdoor welding and cutting involving lead, mercury, and cad-

mium require that the worker wear respiratory protective equipment.

Generation of gases and fumes Oxides of nitrogen from the high-temperature combination of nitrogen and oxygen in the air are always generated near the welding or cutting arc. An inert gas shield, however, minimizes the introduction of air to the arc. Concentrations of these oxides are generally above their MAC or TLV within a few inches of the arc, but are diluted rapidly by air movements. Local exhaust or general ventilation should be used to keep the concentrations of oxides of nitrogen within safe limits.

Ozone—a triatomic form of gaseous oxygen, chemically designated by the symbol O_3 —is formed by ultraviolet radiation acting on oxygen in air. It is a highly toxic and irritating gas. Since ultraviolet radiation passes through the air, ozone may be formed several feet from the welding or cutting arc. The amount of ozone formed depends on the metal and the gas shield being used and the arc temperature. A greater amount of ultraviolet is produced with argon gas shield than with helium. General ventilation will control the production of ozone in the welding or cutting area.

Ultraviolet radiation from the welding or cutting arc can also decompose chlorinated hydrocarbons, such as trichloroethylene and perchloroethylene, to form highly toxic substances. Since this decomposition can occur even at a considerable distance from the arc, degreasing operations and other work using these chlorinated solvents should be located so that no solvent vapor will reach the welding or cutting area.

Inert-gas shielded arc welding requires that much greater precaution be taken to provide respiratory protection than is ordinarily the case with other welding or cutting processes. Depending upon a number of factors, including the particular variety of gas-shielded arc welding to be done, the nature of the materials to be welded, and whether or not the work must be done in a confined space, there will be a need for provision of positive ventilation, local exhaust removal, or approved respiratory equipment, or a combination of them.

Indoor exhaust and ventilation In spaces of 50,000 cu ft and over, where welding is an essential part of the work, local exhaust