INDUSTRIAL HYGIENE FOR WELDING AND CUTTING

Welding, torch brazing, and cutting operations produce fumes and gases that are potential health hazards. Protection from excess exposure is normally accomplished with natural and/or mechanical ventilation. Respiratory protection shall be provided and required when exposure exceeds OSHA permissible exposure limits (PEL's).

I. FUMES

A. Fumes are gaseous products of welding, brazing, or cutting operations. The concentration of fume produced depends on the process and procedure used. SMAW (stick) welding produces much more fume than GTAW (TIG) welding; high amperage produces more fume than low amperage.

B. Typically, the electrode or flux is the major source of fume, not the base metal.

C. Welding, brazing, or cutting on surface coatings such as lead base paints, galvanizing, or cadmium plating may produce hazardous fumes.

D. Material Safety Data Sheets (MSDS's) should be consulted to determine the hazards encountered when using a particular welding rod, wire, or flux.

II. GASES

A. Helium and argon are commonly used shielding gases. Although chemically inert and nontoxic, they become asphyxiants when they displace the atmosphere's oxygen concentration. Helium quickly rises, and argon settles.

B. Carbon dioxide and nitrogen can also cause asphyxiation.

C. Ozone is a toxic gas produced by the intense ultraviolet radiation of an arc.

D. Carbon monoxide is a toxic gas produced by the thermal decomposition of carbon dioxide.

III. EXPOSURE

A. The most important factor influencing exposure to fumes is where the welder's head is in relation to the fume plume. Whenever possible the fume should not be allowed to envelop the helmet, or exposure levels may be very high.

B. The size of the shop or enclosure, the number of welders, the welding or cutting process, and the ventilation are also variables that determine exposure.

C. Food should not be consumed in areas where fumes that contain materials with low PEL's are generated. Good personal hygiene practices will prevent ingestion of these contaminants that settle out of the air.

IV. VENTILATION

A. Adequate ventilation is the key to reducing fume and gas concentrations to safe levels.

B. The most effective ventilation systems capture the fumes near their source and clean them and/or exhaust them away from work areas.

C. Natural ventilation (open doors and windows) and general area ventilation (air conditioning or fans) are effective in preventing build-up of fumes or gases, but should only be supplemental to local exhaust systems when health hazards are high.

D. If work is performed in a confined space, it shall be well ventilated, with adequate oxygen, and the welder must wear a respirator. Pure oxygen shall never be used for ventilation, as an oxygen-rich atmosphere promotes combustion.

E All confined space work must be performed in compliance with section 5063 of the Fermilab E, S & H Manual.

V. RESPIRATORS

A. Respirators shall be worn when natural and mechanical ventilation are not adequate, or where very toxic fumes require supplemental protection. The Medical Department approves/disapproves the use of respirators for each welder.

B. Filter-type respirators, approved for metal fume, are adequate protection for many metal contaminants when used properly.

C. Air-supplied (positive pressure) welding helmets shall be provided for welders not approved to wear face-mask (negative pressure) respirators or if operations that pose extreme hazards are identified.

VI. MEASUREMENT OF EXPOSURE LEVELS

A. OSHA has established Permissible Exposure Limits (PEL's) for toxic materials.

B. To assure that airborne contaminant levels are within the allowable limits, air samples taken at the breathing zone, are analyzed. Both the amount of fume and the composition are determined in a single test.

C. The frequency of air-sample testing is specified by OSHA when PEL's are exceeded. Sampling shall be performed whenever the variable in Section III-B are significantly changed.

D. Copies of the results of air-sample analysis shall be provided to the welders in the work area.