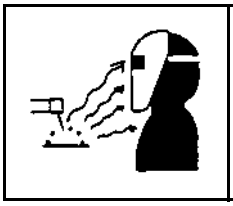

RADIATION

INTRODUCTION

Most arc welding and cutting processes, laser welding, and torch welding, cutting, and brazing, or soldering produce quantities of radiation requiring precautionary measures. Some processes, such as resistance welding and cold pressure welding, ordinarily produce negligible quantities of radiant energy.

DEFINITION

Radiation is electromagnetic energy given off by the arc or flame that can injure eyes and burn skin. An operator sees visible light radiation. However, he does not see ultraviolet or infrared radiation. Radiation is often silent and undetected, yet injury occurs. Have all users learn about the effects of radiation.

EFFECTS OF RADIATION

The effects of radiation depend on the wavelength, intensity, and length of time one is exposed to the radiant energy. Although a variety of effects is possible, the following two injuries are most common:

- Skin burns.
- Eye damage

TYPES OF RADIATION

There are two types of radiation associated with welding operations:

- Ionizing (such as X-rays).
- Nonionizing (such as ultraviolet, visible light, or infrared).

IONIZING RADIATION

- Produced by the electron beam welding process.

- Controlled within acceptable limits by using suitable shielding around the electron beam welding area.

- Produced during grinding (pointing) of thoriated tungsten electrodes for Gas Tungsten Arc Welding (GTAW) process—the grinding dust is radioactive.

- Controlled by using local exhaust and, if necessary, an approved respirator.

NONIONIZING RADIATION

- Intensity and wavelength of energy produced depend on the process, welding parameters, electrode and base metal composition, fluxes, and any coatings or plating on the base material.

- Ultraviolet radiation increases approximately as the square of the welding current.

- Visible brightness (luminance) of the arc increases at a much lower rate.

- Processes using argon produce larger amounts of ultraviolet radiation than those using most other shielding gases.

HOW TO PROTECT AGAINST IONIZING RADIATION

- Required protection varies with time of exposure, distance from source, and shielding used.

- Follow recommended procedures in AWS F2.1.

- When grinding (pointing) thoriated tungsten electrodes, always use local exhaust and, if necessary, respiratory protection to prevent inhalation of dust.

- External radiation from thoriated tungsten electrodes during storage, welding, or disposal of residues is negligible under normal conditions.

HOW TO PROTECT AGAINST NON-IONIZING RADIATION

- Use welding helmet with correct shade of filter plate according to ANSI Z87.1.

  Note: Transparent welding curtains are not intended as welding filter plates, but rather are intended to protect passersby from incidental exposure.

- Protect exposed skin with adequate gloves and clothing according to ANSI Z49.1.

- Be aware of reflections from welding arcs, and protect all persons from intense reflections.

  Note: Paints using titanium dioxide or zinc oxide as major pigmentation media have a low reflectance for ultraviolet radiation.

- Locate welding operations so that other workers are not exposed to either direct or reflected radiation. Use screens, curtains, or adequate distances from other work stations, aisles, or walkways to avoid exposure.

- Wear safety glasses with UV protective side shields in addition to a proper welding helmet with filter plate. The side shields provide needed protection from reflected radiation.

- Have all persons wear safety glasses with UV protective side shields anytime near welding or cutting areas.

- Choose safety glasses according to ANSI Z87.1.

INFORMATION SOURCES ON IONIZING RADIATION

American Welding Society (AWS). *Recommended Safe Practices for Electron Beam Welding and Cutting*, F2.1, available from American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

International Institute of Welding (IIW). *Statement of Commission VIII on Health Aspects in the Use of Thoriated Tungsten Electrodes*, Document VIII–1702–93, available from International Institute of Welding, ZI Paris Nord II, BP 50362, 95942 ROISSY CDG CEDEX, FRANCE.

Manufacturers' Product Information Literature.

INFORMATION SOURCES ON NON-IONIZING RADIATION

American National Standards Institute (ANSI). *Practice for Occupational and Educational Eye and Face Protection*, Z87.1, available from American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

_____. *Safety in Welding, Cutting, and Allied Processes*, Z49.1, available from American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

_____. *Safe Use of Lasers*, Z136.1, available from American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

Hinrichs, J. F. “Project Committee on Radiation—Summary Report.” *Welding Journal* 57(62): 1978.

Moss, C. E., “Optical Radiation Transmission Levels Through Transparent Welding Curtains.” *Welding Journal* 58(69–75s): 1979.

Moss, C. E., et al. “Optical Radiation Levels Produced by Air-Carbon Arc Cutting Processes.” *Welding Journal* 59(43–46): 1980.

Moss, C. E. and W. E. Murray. “Optical Radiation Levels Produced in Gas Welding, Torch Brazing and Oxygen Cutting.” *Welding Journal* 58(37–46): 1979.

National Technical Information Service. *Evaluation of the Potential Hazards from Actinic Ultraviolet Radiation Generated by Electric Welding and Cutting Arcs*, Nonionizing Radiation Protection Special Study No. 42-0053-77. Springfield, Virginia: National Technical Information Service.

_____. *Evaluation of the Potential Retinal Hazards from Optical Radiation Generated by Electric Welding and Cutting Arcs*, Nonionizing Radiation Protection Special Study No. 42-0312-77. Springfield, Virginia: National Technical Information Service.

Sliney, D. H., and Freasier, B. C. “Evaluation of Optical Radiation Hazards,” *Applied Optics*, Vol. 12, pp. 1–24, January 1973.

Naidoff, M. A., and Sliney, D. H. “Retinal Injury from a Welding Arc,” *American Journal of Ophthalmology*, Vol. 77, No. 5, pp. 663–668, May 1974.

Mine Safety and Health Administration (MSHA). *Code of Federal Regulations*, Title 30 Mineral Resources, Parts 1-199, available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

American Welding Society (AWS). *Ultraviolet Reflectance of Paint*, URL, available from American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.