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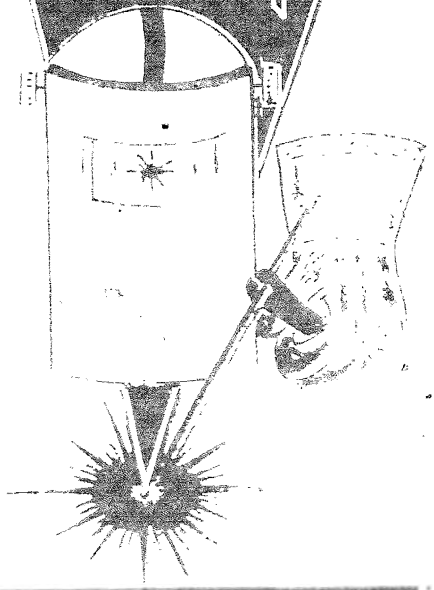
WELDING

SAFELY



U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL
SAFETY AND HEALTH

WELDING SAFELY

Welding is a method of joining two metal surfaces by fusing the contacted surfaces. The American Welding Society has indicated about 40 different types of welding processes in use commercially. Some of the more popular types of welding processes include oxygen-acetylene welding, helium arc welding, carbon arc welding, resistance welding, metal electrode arc welding, and brazing operations. The industrial welding process may be shielded to prevent oxidation and may be completely automatic as with the use of welding machines.

There are several potential health and safety problems associated with welding. However, with properly instituted precautionary measures and work procedures there need be no danger to the health and safety of the welder.

What the Hazards are with Welding

Welding problems will vary with the methods of welding, location of work, materials being welded, and the instituted control measures. Certain hazards are common to most welding processes. Principally, these are damage to the eyes and skin from infrared and ultraviolet radiation, burns from contact with hot metal or sparks, adverse physiological effects from breathing metal fumes and gases, accidents from material handling, and shock from electrical current.

Blinding light is a familiar observation of a welding process. Molten metal manifests infrared radiation, the electric arc produces ultraviolet radiation, and the total operation generates intense visible light. Glare and radiation are a problem to the welder; they also present severe problems to the welder's helper who often lacks normal protective equipment such as goggles and proper clothing. Sudden and pulsating flashes can result in "flash burns" to the eyes. Eye burns are very painful and repeated exposure can cause permanent eye damage. Intense radiant energy may also cause skin damage and can cause cotton clothing to deteriorate. Woolen or leather garments are normally recommended for welders as affording better protection from sparks and fire as well as being more durable. Welding helmets, gloves, goggles of proper type, and other items of protective clothing, are available for providing protection to welders.

The potential harm from gases and fumes generated by a welding operation depends upon the chemical composition of the fume, the concentration in the breathing zone, and the length of worker exposure. The composition of the fume is determined by the various materials involved in the welding process and by the temperature of the welding operation. The more important air contaminants that may be involved are ozone, carbon dioxide, carbon monoxide, the oxides of nitrogen, and the various specific constituents of the rods, rod coatings, and the metal themselves.

The oxides of nitrogen and ozone are the principal toxic gases produced by welding on steel. Ozone, an intensely irritating gas, is produced by the action of the electric arc. Other toxic fumes may be generated if the steel has been coated with various materials or on alloys containing certain materials. Some non-toxic paints may produce toxic fumes when heated under the welding torch. For example, certain phthalic-base paints may give off extremely irritating fumes. Fumes from metals such as copper and zinc are capable of producing metal fume fever. Metal fume fever is self-limiting and is never known to be fatal; however, the distress and discomfort are quite objectionable and for this reason exposure should be controlled.

Most welding is done with coated rods or electrodes. Compounds which are contained in welding rod coatings include oxides of various metals, hydroxides, carbonates, silicates, fluorides, and organic materials. The fluorides are of the greatest significance because of their toxicity and because large amounts are released during welding. The coatings on welding rods used for stainless steel are invariably high in fluorides, and requires strict controls. Fluorides are also present in the fluxes used in some types of welding, brazing, or soldering. Certain of the fluxes used for silver solders contain cadmium, which can produce toxic fumes causing a chemical pneumonitis in man. The welding of alloys, particularly those containing beryllium, can be exceptionally hazardous. Beryllium and its compounds can cause lung disease and certain skin conditions.

The avoidance of electric shock is largely within the control of the welder. Most electric shocks experienced at welding voltages have not caused severe injury; however, these voltages are sufficiently high that under certain conditions they may be lethal. Even mild shocks can produce involuntary muscle contractions leading to injurious falls—sometimes from high places. The severity of the shock is determined largely by the path of the current and the amount flowing through the body; this is determined by the voltage and the contact resistance of the area of skin involved. Wearing clothing damp from perspiration or working in wet conditions reduces skin contact resistance and thus increases the risk of electric shock.

Controlling the Hazards

Welding hazards are controlled by employing proper ventilation principles, using respirators and other personal protective devices including proper clothing, and by following safe working practices in general.

Proper methods for application of local mechanical exhaust ventilation or general dilution ventilation will vary with the type of welding being performed. In open-air welding or in large well-ventilated maintenance shops, the hazards from air-borne contaminants are not likely to be significant except for the more toxic fumes. For these highly toxic fumes and for heavy or production welding in a confined area, mechanical exhaust ventilation should be provided. Air-

supplied respirators or specifically designed local exhaust ventilation should be provided for welding on coated materials containing lead, cadmium, mercury, or other highly toxic materials. Local ventilation controls should be located as near to the welding operation as possible. When welding in confined areas, such as inside tanks or boilers, welders require a supplied air hood or air-supplied respirator.

Goggles or suitable eye protection should be worn during arc welding or cutting operations to provide protection from injurious rays and from flying objects. The helpers or attendants should also be provided with proper eye protection. Helmets, hand shields, and barriers around the operation provide for additional worker protection during the welding process.

Appropriate protective clothing required for any welding operation will vary with the size, nature, and location of work to be performed. Except when engaged in light work, all welders should wear flameproof gauntlet-style gloves. Flameproof aprons made of leather, asbestos, or other suitable materials may also be desirable as protection against radiated heat and sparks. Woolen clothing is preferable to cotton because it is not readily ignited and helps protect the welder from changes in temperature. Flame-resistant leggings, high boots, or other equivalent protection such as metal screens in front of the workers' legs should be used for heavy work. Ear protection may be required for work in extremely confined spaces, over-head welding, or plasma torch applications.

Management Responsibilities

Industrial management can help to prevent injuries to welders by informing them of the potential hazards and how to avoid them. Each supervisor has a definite responsibility to keep the workers in his area informed, to post warning signs, and to enforce safety protection measures. Local or general exhaust ventilation should be provided to control air contaminants as required by the various types of welding processes. Personal protective equipment including eye goggles, helmets, and hand shields, should be provided as required by the type of welding process. Welding operations, when possible, should be isolated from other industrial operations, particularly degreasing tanks or solvent cleaning operations. Even with the level of trichloroethylene well below the maximum safe limit, there is the potential for dangerous concentrations of phosgene or other vapors to occur. Good housekeeping practices should be maintained throughout welding work areas.

Responsibility of Workers

Each worker should properly maintain and operate his welding equipment in such a manner as to avoid undue risk to health and safety. The following general rules and any others issued to protect him should be observed:

1. Abide by safety measures required for each type of welding.
2. Avoid electric shock.
3. Maintain equipment in good mechanical and electrical condition.

4. Be alert to possible fire hazards. Move the object to be welded to a safe location or remove flammable materials from the work area.

5. Utilize all required protective equipment and clothing.

6. Check the ventilation system before starting work and periodically thereafter to insure adequate performance.

7. Never weld inside drums or other confined spaces without adequate ventilation or the use of air-line respirators or self-contained breathing equipment.

8. Never weld in the same working area where degreasing or other cleaning operations are performed.

9. Cooperate with plant management in reporting defective equipment and hazardous working conditions.

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NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

Rockville, Md. 20852

1972

REPRINTED 1973

HSM 72-10201

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

☆ U.S. Government Printing Office: 1973-735-361/116

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