SECTION 10

WELDING AND CUTTING

10.A GENERAL

10.A.01 Welders, cutters, and their supervisor shall be trained in the safe operation of their equipment, safe welding/cutting practices, and welding/cutting respiratory and fire protection.
> AIHA publication "Welding Health and Safety: A Field Guide for OEHS Professionals" is recommended.

10.A.02 All welding equipment shall be inspected before each use to ensure that all required safety devices and ancillary equipment are in place and properly functioning. Defective equipment shall be removed from service, replaced or repaired, and reinspected before again being placed in service.

10.A.03 Electrical and pressurized system requirements.

a. Welding cylinders and their use and maintenance shall meet the applicable requirements of Section 20.

b. Arc welding and cutting systems and their use shall meet the applicable requirements of this section.

10.A.04 Arc welding and cutting operations shall be shielded by noncombustible or flameproof screens that will protect employees and other persons working in the vicinity from the direct rays of the arc, sparks, molten metal, spatter, and chipped slag.

10.A.05 Cable, hoses, and other equipment shall be kept clear of passageways, ladders, and stairways.

10.A.06 Welding and cutting of hazardous materials.

a. When welding, cutting, or heating on steel pipelines containing natural gas, 49 CFR 192 shall apply.

b. Before welding, cutting, or heating is commenced on any surface covered by a preservative coating whose flammability is not known, a test shall be made to determine its flammability. Preservative coatings shall be considered highly flammable when scrapings burn with extreme rapidity.

c. Preservative coatings shall be removed a sufficient distance from the area to be heated to ensure any temperature increase of the unstripped metal will not be appreciable; artificial cooling of the metal surrounding the heating area may be used to limit the area to be stripped.

d. When welding, cutting, or heating toxic surface coatings (paints, preservatives, surface stripping chemicals, etc.) in enclosed spaces, all surfaces covered with the coatings shall be stripped of such for a distance of at least 4 in (10.1 cm) from the area of heat application or the employees shall be protected by airline respirators.

10.A.07 All structural welding performed on critical items, such as scaffolding, shoring, forms, ladders, piling, etc., as well as other critical items as designated by the GDA, shall only be performed by welders certified in accordance with American Welding Society (AWS) standards using qualified and approved welding practices and procedures (AWS certification or approved equivalent organization which trains to AWS standards).

10.A.08 Before heat is applied to a drum, container, or hollow structure, a vent or opening shall be provided for the release of any built-up pressure generated during the application of heat.

10.A.09 Employees performing welding, cutting, and heating work shall be protected by PPE appropriate for the hazards that they may encounter and based upon the results of an AHA conducted specifically for the welding, cutting, or heating operation that they will be performing. All required respiratory, eye and face, noise, head, foot, and skin protection equipment shall be selected and used in accordance with Section 5.

10.A.10 All welding and cutting equipment and operations shall be in accordance with standards and recommended practices of American National Standards Institute (ANSI)/American Welding Society (AWS) Z49.1.

10.B RESPIRATORY PROTECTION

10.B.01 All welding, cutting, and heating operations shall be ventilated (natural or mechanical) such that personnel exposures to hazardous concentrations of airborne contaminants are within acceptable limits. ***> See Section 6.***

10.B.02 Welding, cutting, and heating not involving conditions or materials described in this Section may normally be done without mechanical ventilation or respiratory protective equipment.

10.B.03 Either general mechanical or local exhaust ventilation shall be provided whenever welding, cutting, or heating is performed in a confined space. ***> See 10.A.06.d and 10.B.05.***

10.B.04 Materials of toxic significance. Welding, cutting, or heating operations that involve or generate any of the substances listed below shall be performed in accordance with the following subparagraphs: Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Chromium (VI), Cobalt, Copper, Lead, Manganese, Mercury, Nickel, Ozone, Selenium, Silver, or Vanadium. ***> See also 10.A.06.d.***

a. Whenever these materials are encountered in confined spaces, local mechanical exhaust ventilation and personal respiratory protective equipment shall be used. The use of local mechanical exhaust ventilation systems that permit the re-entry of exhaust air back into the work area, or local exhaust which incorporate a system for the filtration and recirculation of exhaust air back into the work area shall not be permitted.

b. Whenever these materials, except beryllium and chromium (VI), are encountered in indoor operations, local mechanical exhaust ventilation systems that are sufficient to reduce and

maintain personal exposures to within acceptable limits shall be used. The use of local mechanical exhaust systems that permit the re-entry of exhaust air back into the work area, or that include a system for the filtration and the recirculation of exhaust air back into the work area are not permitted. When either beryllium or chromium (VI) is encountered in indoor operations, approved local mechanical exhaust ventilation systems and personal respiratory protection shall be used.

c. Whenever these materials, except beryllium and chromium (VI), are encountered in outdoor operations, and local mechanical exhaust ventilation systems sufficient to reduce and maintain personal exposures to within acceptable limits are not provided, then appropriate respiratory protective equipment shall be used.

d. Whenever beryllium and chromium (VI), are encountered in outdoor operations, the need for and type of engineering and work practice controls to be implemented, as well as the need for and type of respiratory protection to be provided shall be based upon the results of an initial worker exposure assessment and exposure determination with regards to these substances.

e. Workers may be exposed to hazardous concentrations of chromium (VI) while welding, cutting or performing hot work on stainless steel, high chrome alloys or chrome-coated metal, or during the application and removal of chromate-containing paints and other surface coatings. ***> See OSHA's Standard for Hexavalent Chromium (Chromium (VI), 29 CFR 1926.1126.***

10.B.05 Welding, cutting, or heating operations that involve or generate fluorine or zinc compounds shall be performed in accordance with the following:

a. In confined spaces, local mechanical exhaust ventilation and personal respiratory protection sufficient to maintain exposures to within acceptable limits shall be used.

b. In open spaces, sampling shall be performed to determine concentrations of fluorides or zinc compounds and the need for local exhaust ventilation and personal respiratory protection sufficient to maintain exposures to within acceptable limits.

10.B.06 Arc and gas cutting. Oxygen cutting using either an iron powder or chemical flux, gas-shielded arc cutting, and plasma cutting shall employ local mechanical exhaust ventilation or other means adequate to remove the fumes generated.

10.B.07 Other persons exposed to the same atmosphere as welders or cutters shall be protected in the same manner as welders or cutters.

10.C FIRE PROTECTION

10.C.01 Suitable fire extinguishing equipment of sufficient capacity shall be provided in the immediate vicinity of welding or cutting operations and maintained in a state of constant readiness for immediate use. Hot work permits shall be required on Government installations when welding, cutting, or heating operations are performed unless otherwise indicated by the GDA.

10.C.02 Before conducting welding or cutting operations, the area shall be surveyed to ensure it is free of the following hazards:

a. Proximate combustible materials,

b. The presence or possible generation of potentially explosive atmospheres (flammable gases, vapors, liquids, or dusts); and

c. The presence or nature of an oxygen-enriched atmosphere.

10.C.03 Hierarchy of fire control. Objects to be welded, cut, or heated shall be:

a. Moved to a location free of dangerous combustibles;

b. If the work cannot be moved, all moveable fire hazards in the vicinity shall be taken to a safe place (moved at least 35 ft (10.6 m) horizontally from the welding or cutting area) or the combustible material and construction shall be protected from the heat, sparks, and slag of welding;

c. When welding or cutting must be done in a location where combustible or flammable materials are located, inspection and authorization by the GDA shall be required before such operations are begun (the location shall be checked for latent fires by qualified fire watch personnel after the work is completed).

10.C.04 When a welding, cutting, or heating operation is such that normal fire prevention precautions are not sufficient, additional qualified fire watch personnel shall be assigned to guard against fire and shall be instructed in anticipated fire hazards and how fire fighting equipment is to be used. ***> See 09.J.03,***

10.C.05 When welding or cutting is to be done over combustible flooring, the flooring shall be protected by fire-resistant shielding, covered with damp sand, or kept wet. Where flooring is wet or damp, personnel operating arc welding or cutting equipment shall be protected from potential shock hazards.

10.C.06 Noncombustible barriers shall be installed below welding or burning operations in a shaft or raise,

10.C.07 Openings or cracks in walls, floors, or ducts within 35 ft (10.6 m) of the site of welding or cutting operations shall be tightly covered to prevent the passage of sparks to adjacent areas.

10.C.08 Where welding or cutting is to be done near walls, partitions, ceilings, or roofs of combustible construction, fire resistant guards shall be provided to prevent ignition.

10.C.09 Where welding or cutting is to be done on a metal wall, partition, ceiling, or roof, precautions shall be taken to prevent

ignition, due to heat conduction or radiation, of combustibles on the other side.

10.C.10 Welding or cutting shall not be done on a metal partition, wall, ceiling, or roof with a combustible covering nor on walls or partitions of combustible sandwich-type panel construction.

10.C.11 Before welding or cutting drums, tanks, or other containers and equipment that have contained hazardous materials, the containers shall be thoroughly cleaned in accordance with NFPA 326 and ANSI/AWS F4.1.

10.C.12 Hot tapping or other welding or cutting on a flammable gas or liquid transmission or distribution pipeline shall be performed only by personnel qualified to make hot taps and only with the permission of the GDA.

10.C.13 When welding or cutting is to be conducted near a sprinkler head, a wet cloth or equivalent protection shall be used to cover the sprinkler head and then removed at the completion of the welding or cutting operation.

10.C.14 When welding or cutting in areas protected by fire detection and suppression systems, precautions shall be taken to avoid accidental initiation of these systems.

10.D OXYFUEL GAS WELDING AND CUTTING

10.D.01 Oxyfuel gas welding and cutting equipment shall be listed by a nationally-recognized testing laboratory.

10.D.02 Oxygen cylinders and apparatus.

a. Oxygen cylinders and apparatus shall be kept free from oil, grease, and other flammable or explosive substances and shall not be handled with oily hands or gloves.

b. Oxygen cylinders and apparatus shall not be used interchangeably with any other gas.

10.D.03 Hose and hose connections.

a. Fuel gas hose and oxygen hose shall be readily distinguishable from each other.

b. Oxygen and fuel gas hoses shall not be interchangeable. A single hose having more than one gas passage shall not be used.

c. Hose couplings of the type that can be unlocked or disconnected without a rotary motion are prohibited.

d. Hose that has been subject to flashback or that shows evidence of severe wear or damage shall be tested to twice the normal pressure to which it is subjected, and in no case less than 300 psi (2068.4-kPa) gauge. Damaged hose and hose connectors, or hose and hose connectors in questionable condition, shall not be used.

e. When parallel runs of oxygen and fuel gas hose are taped together, not more than 4 out of every 12 in (10 out of every 30.4 cm) shall be covered by tape.

f. Boxes used for the storage of gas hose shall be ventilated.

g. Hose connections shall be clamped or otherwise securely fastened in a manner that will withstand, without leakage, twice the pressure to which they are normally subjected in service, but not less than 300 psi (2,068 kPa) gauge.

10.D.04 Torches.

a. Torches shall be inspected before each use for leaking shutoff valves, hose couplings, and tip connections. Defective torches shall not be used.

b. Hoses shall be purged individually before lighting the torch for the first time each day. Hoses shall not be purged into confined spaces or near ignition sources.

c. Clogged torch tip openings shall be cleaned with suitable cleaning wires, drills, or other devices designed for such purposes.

d. Torches shall be lighted by friction lighters or other approved devices, not by matches or from hot work.

10.D.05 Torch valves shall be closed and the gas supply shut off whenever work is suspended.

10.D.06 The torch and hose shall be removed from confined spaces whenever work is suspended.

10.D.07 Protective equipment.

a. Oxyfuel gas, and other oxygen-fuel gas welding and cutting systems using cylinder-regulator-hose-torch shall be equipped with both a reverse-flow check valve and a flash arrestor, in each hose, at the torch handle or at the regulator.

b. When oxygen-fuel gas systems are manifolded together the provisions of NFPA 51 shall apply.

10.D.08 Connection of multiple sets of oxyacetylene hoses to a single regulator on a single set of oxyacetylene tanks may only be accomplished by installing a commercially available fitting approved by Compressed Gas Association (CGA) standards and listed by a nationally-recognized testing laboratory. The fitting shall be installed on the output side of the regulator and shall have a built-in shut-off valve and reverse-flow check valve on each branch.

10.D.09 Acetylene regulators shall not be adjusted to permit a discharge greater than 15 psi (103.4 kPa) gauge.

10.E ARC WELDING AND CUTTING

10.E.01 Electric welding apparatus shall be installed, maintained, and operated in accordance with the NEC.

10.E.02 Manual electrode holders.

a. Only manual electrode holders specifically designed for arc welding and cutting of a capacity capable of safely handling the maximum rated current required by the electrodes shall be used.

b. All current carrying parts passing through the portion of the holder that is gripped by the welder or cutter, and the outer surfaces of the jaws of the holder, shall be fully insulated against the maximum voltage encountered to ground.

10.E.03 Welding cables and connectors.

a. Cables shall be completely insulated, flexible, capable of handling the maximum current requirements of the work in progress, and in good repair. Cables in need of repair shall not be used.

b. Welding cables shall be inspected for wear or damage before each use. Cables with damaged insulation or connectors shall be replaced or repaired to achieve the same mechanical strength, insulating quality, electrical conductivity, and water tightness of the original cable. Cables containing splices or repaired insulation within a minimum distance of 10 ft (3 m) from the end of the cable to which the electrode holder is connected shall not be used.

c. Where it becomes necessary to connect or splice lengths of cable together, insulated connectors of a capacity at least equivalent to that of the cable shall be used. When connections are affected by cable lugs, they shall be securely fastened together to give good electrical contact and the exposed metal parts of the lugs shall be completely insulated. The joining of

lengths of cable shall be accomplished by methods specifically intended for that purpose and connection methods shall provide insulation adequate for the service conditions.

10.E.04 The frames of arc welding and cutting machines shall be grounded either by a third wire in the cable connecting the circuit conductor or by a separate wire that is grounded at the source of the current.

10.E.05 Neither terminal of the welding generator shall be bonded to the frame of the welder.

10.E.06 Pipelines containing gases or flammable liquids or conduits carrying electrical conductors shall not be used for a ground return circuit.

10.E.07 Circuits from welding machines used for other than welding tools shall be grounded.

10.E.08 Welding supply cables shall not be placed near power supply cables or other high-tension wires.

10.E.09 Welding leads shall not be permitted to contact metal parts supporting suspended scaffolds.

10.E.10 Switching equipment for shutting down the welding machine shall be provided on or near the welding machine.

10.E.11 Equipment shall be shut down when the leads are unattended.

10.E.12 Arc welding and cutting operations shall be shielded by noncombustible or flameproof screens to protect employees and other visitors from the direct rays of the arc.

10.E.13 Coiled welding cable shall be spread out before use.

10.F GAS METAL ARC WELDING

10.F.01 Chlorinated solvents shall be kept at least 200 ft (61 m) away from the exposed arc, unless shielded. Surfaces prepared with chlorinated solvents shall be dry before welding is permitted on such surfaces.

10.F.02 Persons in the area not protected from the arc by screening shall be protected by filter lenses. When two or more welders are exposed to each other's arc, filter lens goggles shall be worn under welding helmets. Hand shields shall be used to protect the welders against flashes and radiant energy when either the helmet is lifted or the shield is removed.

10.F.03 Welders and other persons who are exposed to radiation shall be protected so that the skin is covered to prevent burns and other damage by ultraviolet rays. Welding helmets and hand shields shall be free of leaks, cracks, openings, and highly reflective surfaces.

10.F.04 When gas metal arc welding is performed on stainless steel, chrome alloy steel, or chrome-coated metal, personnel shall be protected against dangerous concentrations of nitrogen dioxide and other air contaminants such as chromium (VI), by means of an approved local exhaust ventilation system that is capable of reducing and maintaining personal exposures to within permissible limits, or by means of other effective work practice and engineering controls such as the use of an argon-rich (> 75% argon) shielding gas for use in gas metal arc welding (GMAW) or flux cored arc welding (FCAW) operations. Wherever engineering and work practice controls are not sufficient to reduce employee exposures below permissible limits, the employer shall use them to reduce employee exposures to the lowest levels achievable, and shall supplement such methods by the use of respiratory protection that complies with the requirements of this Section and Section 05.