North Carolina Agricultural and Technical State University
OFFICE OF ENVIRONMENTAL HEALTH & SAFETY

Safety Manual

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Approved By: Louisa V. Newman Director of Environmental Health & Safety	Signature:

Hot Work – Welding and Cutting Safety Policy

Purpose: This policy is to ensure North Carolina Agricultural and Technical State University (NC A&T) employee safety during welding and cutting operations along with the protection of property (including equipment) from Hot Work operations conducted at the University. Hot Work is defined as "work involving burning, welding, or similar operation that is capable of initiating fires or explosions."

References:

1. American National Standards Institute, Standard: Z49.1:2005, Safety in Welding, Cutting, and Allied Processes
2. National Fire Protection Agency 51B, Standard for Fire Prevention during Welding, Cutting and Other Hot Work.
3. American Welding Society, Safety and Health Fact Sheets
4. OSHA General Industry Standard, Subpart Q, 1910.251- 1910. 255 Welding, Cutting, and Brazing
5. U.S. Army Corps of Engineers, Safety and Health Manual, Section 10 Welding and Cutting
6. Washington State Department of Labor and Industries, Hexavalent Chromium (chrome 6) Training on the hazards of hexavalent chromium in the workplace

Responsibilities:

Environmental Health & Safety (EHS): is responsible for reviewing hazards and incidents associated with Hot Work conducted on campus along with developing training programs for Hot Work operations, performing health hazard evaluations, and performing safety inspections of welding work areas and equipment.

Supervisor: Supervisors are responsible in making sure employees who will be performing Hot Work operations are properly train on the NC A&T procedures before performing work on campus. A Job Safety Analysis (JSA) should be developed that provides specifies written rules and instructions covering when Hot Work Permit is required, the safe operation of equipment, incorporating information from Safety Data Sheets (SDS) welding materials used, appropriate Personal Protective Equipment (PPE), evaluation of combustible materials and hazardous areas present or likely to be present in the work location.

Whenever a Hot Work Permit is required, the Supervisor is responsible for designating the following:

- Hot Work Operator: Is the employee who is qualified and authorized by management to perform hot work such as welding, brazing, soldering, and other associated work tasks.
- Permit Authorizing Individual: is the Departmental employee who trained and is authorized to issue a hot work permit by management.
- Fire Watch Person: is the Department employee who is trained in hot work safety and monitors the hot work area for changing conditions and watches for fires and extinguishes them if possible.

Employee: Employee performing hot work SHALL:

- Before use of welding equipment, read and understand all safety practices outlined in the manufacture instruction manual for the specific type(s) of welding equipment used for the work process. Read and understand Safety Data Sheets (SDSs), and Work Unit Specific Safety Practices (e.g. SOPs, JSA) and safety requirements of this Policy.
- Employees performing hot work, EHS Individual(s) (PAI), Fire Watches, and Supervisors of hot work operations, must complete annual Fire Safety Training ("hands-on") and complete the Hot Work Safety Training.
- Inspect all welding equipment daily prior to use.
- Shall perform a hazard assessment before work or during any unusual welding operations are planned.
- Shall follow all the safety requirements outlined in the issued Hot Work Permit.
- Use all required welder personal protective equipment for the specific job.
- Report any unsafe condition immediately to the Supervisor.

Hazard Identification and Prevention

Fire prevention and protection for welding and cutting: Welding, cutting, and allied processes produce molten metal, sparks, slag, and hot work surfaces can cause fire or explosion if precautionary measures are not followed.

Flying sparks are the main cause of fires and explosions in welding and cutting. Sparks can travel up to 35 feet from the work area. Sparks and molten metal can travel greater distances when falling. Sparks can pass through or become lodged in cracks, clothing, pipe holes, and other small openings in floors, walls, or partitions. Typical combustible materials found inside buildings include: wood, paper, rags, clothing, chemicals, flammable liquids and gases, and dusts. Parts of buildings such as floors, partitions, and roofs may also be combustible. Welding and cutting can cause explosions in spaces containing flammable gases, vapors, liquids, or dusts.

Fire Hazard Prevention Tips:

- Whenever possible, relocate from the work site to the welding/maintenance shop area. Welding and cutting operations shall ideally be conducted in a separate, well-ventilated room with a fire-retardant floor.
- When not possible to relocate work to the welding shop: remove combustible materials for a minimum radius of 35 feet (10.7 meters) around the work area or move the work to a location well away from combustible materials.
- Protect combustibles with covers made of fire-resistant materials (see below for a description of approved fire-resistant materials for hot work).
- If possible, enclose the work area with portable, fire-resistant screens.
- Cover or block all openings, such as doorways, windows, cracks, or other openings with fire resistant material.
- When needed, have a qualified firewatcher in the work area during and for at least 30 minutes after hot work is finished.
- Do not dispose of hot slag in containers holding combustible material.
- Fire extinguishers shall be maintained in a state of readiness for instant use.
- Welding or cutting is not permitted in or near rooms containing flammable or combustible liquids, vapors, or combustible dusts. Do not weld or cut in atmospheres containing reactive, toxic, or flammable gases, vapors, liquids, or dust.
- Do not apply heat to a work piece covered by an unknown substance or coating that can produce flammable, toxic, or reactive vapors when heated.

- Provide safety supervision for outside contractors conducting hot work. Inform contractors about site-specific hazards including the presence of flammable materials.

Hot work permit requirements: Employees that perform hot work outside of designated Welding Shop and Maintenance Shop areas must complete a NC A&T Hot Work Permit prior to conducting hot work operations and post the original permit at job site and provide EHS with a copy of the final sign-off (after work is completed). The Supervisor, EHS, and Hot Work Operator are responsible for ensuring compliance with the permit requirements. The information contained on the NC A&T Hot Work Permit is based from *NFPA 51B, Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*.

EHS must document the following on the Hot Work Permit:

1. Date the Permit is being issued. A Permit is only valid for one day of work.
2. Building/Location/Floor Level where hot work will be taking place.
3. Document type of work to be performed (i.e. Overhead MIG Welding)
4. EHS then shall inspect the work area and confirm that precautions have been taken to prevent a fire. EHS must complete the checklist outlined on the Hot Work Permit which includes observing special precautions needed during work such as posting a fire watch, and ensuring the hot work location is free from hazards within 35 feet of the work area where hot work is planned.
5. Document any special precautions for the work to be performed such as the use of supplemental fire extinguishers, welding blankets, welding curtains, and ensuring combustible materials are not present and guarding materials that cannot be relocated as a last line of defense where hot work is planned.
6. EHS must inspect if hot work is planned near or on walls, ceilings, and roofs. These areas must be inspected for fire hazards.
7. Hot work is prohibited on enclosed equipment, such as in, on, near tanks, vessels, or containers that contain or have contained flammable substances.
8. Hot work is prohibited in areas with the accumulation of dusts.
9. EHS must ensure that the Fire Watch is provided during hot work and for 30 minutes after the completion of hot work.
10. EHS must ensure the Fire Watch is supplied with appropriate fire extinguishers and/or fire suppression equipment (e.g. water hose).
11. The Fire Watch must be able to activate the fire alarm and be able to contact the Fire Department in the event of an emergency.
12. EHS must determine if more than one fire watch is required in adjoining areas, above level and below areas.
13. The Fire Watch must perform a final check of the work area and adjacent areas to which sparks and heat might spread (including floors above and below, and on opposite side of wall(s). 30 minutes after the hot work was completed and verify with the PAI that the area was found safe.
14. After completion of the Hot Work Permit, a copy of the completed Permit must be submitted to EHS.

Hot work locations: Hot work is never permitted in certain types of locations where safe conditions do not exist and cannot be created. Hot work is allowed in two types of locations:

Designated Area

A permanent location approved for routine hot work operations made safe by removal of all possible sources of ignition that could be ignited by the hot work tool. An

example is the Welding Shop or Maintenance Shop where all combustibles have been removed. A Hot Work Permit **is not** required in a Designated Hot Work Area.

Controlled Area

One in which safe conditions for hot work exist or where safe conditions can be created by moving or protecting combustibles. An example of a controlled area is in a campus building construction area where welding must take place and the work area has been made safe by removing all combustibles and implementing the requirements of the hot work permit to make it safe.

- In a Controlled Area, a Hot Work Permit must be obtained by the hot work operator.
- The permit must be obtained from EHS before the hot work can proceed in a controlled area.
- Refer to the next page of this Policy for the NC A&T Hot Work Permit that is to be used before commencing hot work activities.
- A Hot Work Permit is good for only one day of work.

Non-Permissible Locations

A location that cannot be made safe for hot work and hot work is not permitted in these locations. An example is near closed tanks that contain or have contained flammable liquids such as a fuel tank.

Welding and hot work in and around tanks: NC A&T adheres to U.S. Chemical Safety Board recommendations for welding or cutting operations in or near tanks. Whenever possible, avoid hot work and consider alternative methods. Analyze the hazards, prior to initiation of hot work perform a hazard assessment that identifies the scope of work, potential hazards, and methods of hazard control.

- Work is not allowed and shall not be performed in or near closed tanks that contain or have contained flammable liquids. The tanks must be thoroughly drained, purged, and atmospherically tested with a combustible gas meter (indicator). This will ensure the tank is free from the accumulation of flammable gases or vapors.
- Once approved safe for hot work, atmospheric monitoring must be performed using a portable combustible gas analyzer before and during the work by only trained personnel (PAIs or EHS staff). Assistance can be obtained with atmospheric monitoring by contacting EHS Department at 336-334-7992.
- If any detectable readings are obtained, then work cannot begin or continue until the source of vapor is found and suitably mitigated such that the concentration is maintained below 10% of the Lower Flammable/Explosive Limit. For technical assistance regarding combustible gas meters, contact EHS at 336-334-7992.

Electric shock hazards and safety precautions: Electric shock from electrical welding and cutting equipment can result in death or severe burns. Additionally, serious injury can occur if the welder falls because of the shock. This safety hazard is associated with operations that use electricity to generate heat, such as arc and resistance welding and cutting.

Employees are to use proper precautionary measures and recommended safe practices always to avoid electrical shocks. Personnel using electrical welding and cutting equipment must be trained on safe work practices and procedures before use of this equipment. Some measures to prevent electrical shock include:

- Never use a bare hand or wet glove to change electrodes.
- Do not touch an energized electrode while you are in contact with the work circuit.

- Never stand on a wet or grounded surface when changing electrodes.
- Do not allow the electrode holder or electrode to come in contact with any other person or any grounded object.
- Ground the frames of welding units.
- Insulate yourself from the workpiece and ground using dry insulating mats or covers big enough to prevent any physical contact with the work or ground, or wear properly designed and approved rubber-soled boots in good condition.
- If utilizing long lengths of cable, suspend them overhead whenever possible. If run along the floor, be sure they do not create a tripping hazard, become damaged, or tangled.
- Additional safety precautions are required when welding is performed under any of the following electrical hazardous conditions: in damp locations or while wearing wet clothing, on metal floors, gratings, scaffolds, or other metal structures; in cramped positions such as sitting, kneeling, or lying; or when there is a high risk of unavoidable or accidental contact with the workpiece and ground. Where these conditions are present, use one of the following types of equipment presented in order of preference:
    1. Semiautomatic DC constant voltage metal electrode (wire) welder,
    2. DC manual covered electrode (stick) welder,
    3. AC welder with reduced open-circuit voltage. In most situations, use of a DC constant voltage wire welder is recommended. And do not work alone!

Ventilation requirements for welding: Adequate ventilation shall be provided for all welding and cutting and related operations. Adequate ventilation shall be enough ventilation such that personnel exposures to hazardous concentrations of airborne contaminants are maintained below the allowable limits.

Ventilation is used to control overexposures to the fumes and gases during welding and cutting. Adequate ventilation will keep the fumes and gases from the welder's breathing zone. The heat of the arc or flame creates fumes and gases (fume plume). Fumes contain respirable particles. Gases include the shielding gas, and combustion products. The heat from the arc or flame causes the fume plume to rise. Overexposure to welding fumes and gases can cause dizziness, illness, and even unconsciousness and death.

The following measures and precautions are to be instituted to protect employee health:

- General Welder Safety Precautions: Keep your head out of the fume plume. Reposition the work, your head, or both to keep from breathing smoke and fumes. Do not breathe the fumes. Use ventilation to control the fumes and gases produced from cutting and welding.
- Adequate ventilation: 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. Adequate ventilation can be obtained through natural or mechanical means or both.
    1. Natural ventilation is the movement of air through a workplace by natural forces. Roof vents, open doors and windows provide natural ventilation. The size and layout of the area/building can affect the amount of airflow in the welding area. Natural ventilation can be acceptable for welding operations if the contaminants are kept below the allowable limits.
    2. Mechanical ventilation is the movement of air through a workplace by a mechanical device such as a fan. Mechanical ventilation is reliable. It can be more effective than natural ventilation. An example is a local exhaust ventilation system. These systems include a capture device, ducting, hood, and a fan. The capture devices remove fumes and gases at their source. Some systems filter the airflow before exhausting it. Fixed or moveable capture devices are placed near or around the

work. They can keep contaminants below allowable limits. When using mechanical ventilation remember to:

a. Locate the hood as close as possible to the work.
b. Position the hood to draw the plume away from the breathing zone.
c. Curtains may be used to direct airflow.

- Cutting of Stainless Steel: Oxygen cutting, using either a chemical flux or iron powder or gas-shielded arc cutting of stainless steel, shall be done using mechanical ventilation adequate to remove the fumes generated.
- The following is an illustration of a portable mechanical local exhaust system (property of Energy Services, Chilled Water Services) that is used for welding and cutting hot work at off site locations. It has been used by other Departments during hot work. EHS endorses the use of this type of system to help control welding fumes when welding and cutting outside of shop areas.

Personal protective equipment for welding and cutting: Employees exposed to the hazards created by welding, cutting, or brazing operations shall be protected by personal protective equipment (PPE) in accordance with the requirements of OSHA standard 1910.132. Appropriate protective clothing required for any welding operation will vary with the size, nature and location of the work to be performed. PPE must protect against hazards such as burns, sparks, spatter, electric shock, and optical radiation.

Body Protection: Clothing shall provide sufficient coverage, and be made of suitable materials, to minimize skin burns caused by sparks, spatter, or radiation. Wear oil-free protective clothing made of wool or heavy cotton. Heavier materials work best. Choose clothing that allows freedom of movement and covers all areas of exposed skin. Wear long sleeved shirts (no t-shirts), and button the cuffs, pockets, and collar. They will protect your arms and neck from exposure and skin burns. Wear leather aprons (leather or other material that protects against radiated heat and sparks), leggings, capes, and sleeves as needed for the application. Keep clothing dry. Change it when needed (this reduces the possibility of electric shock). Keep clothing clean (free of oil, grease, or solvents which may catch fire and burn easily). Keep it in good repair (no holes, tears, or frayed edges). Always follow the manufacturer's direction for their use, care, and maintenance. Remove all flammables and matches and cigarette lighters from your pockets. Do not wear synthetic (man-made) fabrics because they may burn easily, melt, stick to your skin, and cause serious burns.

Foot and leg protections: Wear leather, steel-toed, high-topped boots in good condition. They will help protect your feet and ankles from injury. In heavy spark and slag areas, use fire-resistant boot protectors or leather spats strapped round your pant legs and boot tops to prevent injury and burns. Do not wear pants with cuffs. Wear the bottoms of your pants over the tops of your boots to keep out sparks and flying metal. Do not tuck pant legs into your boots.

Hand protection: Wear flame-resistant gloves, such as leather welder's gloves. Always wear dry, hole-free, insulated welding gloves in good condition. They will help protect your hands from burns, sparks, heat, cuts, scratches, and electric shock.

Hearing protection: If loud noise is present, wear approved ear plugs or ear muffs to protect your hearing and prevent hearing loss. When working out of position, such as overhead, wear approved earplugs or muffs. They prevent sparks, spatter, and hot metal from entering your ears and causing burns.

Respiratory protective protection: When controls such as ventilation fail to control airborne contaminants to allowable levels or when the implementation of such controls is not feasible, respiratory protective equipment shall be used to protect employees from hazardous concentrations of air contaminants. Only approved respiratory protection (NIOSH approved respirators) shall be used and employee use of respirators must meet the University Respiratory Protection Program Requirements.

Eye and face protection: Welding, cutting, and allied hot work processes presents various hazards to the welder's eyes and face: the intense heat from arc rays and welding sparks can cause burns to the skin and eyes, during electric welding and welding processes. Personal Protective Equipment for the eyes and face is very important for both the welder and other personnel working near welding operations. Filter lens shall be in accordance with ANSI Z87.1.

For Electric Arc Welding and Arc Cutting: Helmets with filter lenses and cover lenses shall be used by operators and nearby personnel when viewing the arc. For electric welding, the minimum lens shade should be at least #10. If the electrodes are larger than 5/32″ a darker lens compensates for the additional amperage required for the electrode. If the process uses a shielding gas, the lens shade should increase to at least #11 or #12. A darker shade is necessary because the presence of the gas increases the reflective intensity of the arc. See the below OSHA welding and cutting lens selector guide for the selection of welding lens for this process.

For Oxyfuel Gas Welding and Cutting: Welding helmets with a filter lens of #5 is the minimum protection for gas welding and cutting; however, the protection required may increase to shade #8 dependent on the operation. Goggles or other approved eye protection shall be worn by persons in the work area during oxyfuel gas welding and cutting operations. See the below OSHA welding and cutting lens selector guide for the selection of welding lens for this process.

For Other Work Associated with Welding (Such as Grinding): Welding helmets with filter lenses are intended to protect users from arc rays and from weld sparks and spatter which impinge directly against the helmet. They are not intended to protect against slag chips, grinding fragments, wire wheel bristles, and similar hazards. Spectacles with side shields or impact safety goggles, combined with the use of a face shield approved at the ANSI Z87+ level is required for protection against these hazards. The PPE should be stamped ANSI Z87+. The spectacles or goggles may have either clear or filtered lenses, depending upon the amount of exposure to adjacent welding or cutting radiation. Others in the immediate welding area should wear similar eye protection.

OSHA welding lens selector guide: The following is a guide for the selection of the proper shade numbers for welding and cutting eye protection. These recommendations may be varied to suit the individual's needs to protect against infrared and ultraviolet light.

Welding Operation	**Suggested Shade No.**
Shielded metal-arc welding – 1/16-, 3/32-, 1/8-, 5/32-inch electrodes	10
Gas-shielded arc welding (nonferrous) – 1/16-, 3/32-, 1/8-, 5/32-inch electrodes	11

Gas-shielded arc welding (ferrous) – 1/16-, 3/32-, 1/8-, 5/32-inch electrodes	12
Shielded metal-arc welding: 3/16-, 7/32-, 1/4-inch electrodes	12
5/16 -, 3/8-inch electrodes	14
Atomic hydrogen welding	10 thru 14
Carbon arc welding	14
Soldering	2
Torch brazing	3 or 4
Light cutting, up to 1 inch	3 or 4
Medium cutting, 1 inch to 6 inches	4 or 5
Heavy cutting, 6 inches and over	5 or 6
Gas welding (light) up to 1/8 inch	4 or 5
Gas welding (medium) 1/8 inch to 1/2 inch	5 or 6
Gas welding (heavy) 1/2 inch and over	6 or 8

NOTE: In gas welding or oxygen cutting where the torch produces a high yellow light, it is desirable to use a filter or lens that absorbs the yellow or sodium line in the visible light of the operation.

Approved fire-resistant materials for hot work areas

*Welding blankets and curtains are required to be listed, approved, or the equivalent for such use. One such approval includes ANSI/FM 4950, *American National Standard for Evaluating Welding Pads, Welding Blankets and Welding Curtains for Hot Work Operations*.

Welding blanket: A heat-resistant fabric designed to be placed near a hot work operation. Intended for use in horizontal applications with light to moderate exposures such as that resulting from chipping, grinding, heat treating, sand blasting, and light horizontal welding. Designed to protect machinery and prevent ignition of combustibles such as wood that are located adjacent to the underside of the blanket. They are made from different materials such as fiberglass, Silica, and other fire-resistant materials.

Welding pads: A heat-resistant fabric designed to be placed directly under a hot work operation such as welding or cutting. Welding pads are intended for use horizontal applications with severe exposures such as that resulting from molten substances of heavy horizontal welding. Designed to prevent the ignition of combustibles that are located adjacent to the underside of the pad.

Welding curtain: A heat-resistant fabric designed to be placed in the vicinity of a hot work operation. Intended for use in vertical application with light to moderate exposures such as that resulting from chipping, grinding, heat treating, and light horizontal welding. Designed to prevent sparks from escaping a confined area.

Most common types of welding and cutting operations

Oxyfuel gas welding and cutting operations: This section covers safety practices for users of oxyfuel gas welding. For additional specific safety requirements for Oxygen-fuel gas welding and cutting operations, refer to OSHA standard 1910.253.

Oxygen cylinders and apparatus: Oxygen cylinders and apparatus shall be kept free from oil, grease, and other flammable or explosive substances. Oxygen cylinders or apparatus shall not be handled with oily hands or gloves. Oxygen cylinders and apparatus shall not be used interchangeable with any other gas. Oxygen shall not be used as a substitute for compressed air. Oxygen shall not be used for any other work purpose other than welding and cutting (e.g. do not use to blow out pipelines, to dust clothing, do not strike against an oily surface, greasy clothing, or enter fuel oil other storage tanks, etc). Inside of buildings, cylinders shall be stored in a well-protected, well-ventilated, dry location, at least 20 (6.1 m) feet from highly combustible materials such as oil or excelsior. Cylinders should be stored in definitely assigned places away from elevators, stairs, or gangways. Assigned storage spaces shall be located where cylinders will not be knocked over or damaged by passing or falling objects, or subject to tampering by unauthorized persons.

Cylinders shall not be kept in unventilated enclosures such as lockers and cupboards. Empty cylinders shall have their valves closed. Valve protection caps, where cylinder is designed to accept a cap, shall always be in place, hand-tight, except when cylinders are in use or connected for use.

Oxygen cylinders shall not be stored near highly combustible material, especially oil and grease; or near reserve stocks of other fuel-gas cylinders, or near any other substance likely to cause or accelerate fire; or in an acetylene generator compartment.

Oxygen cylinders in storage shall be separated from fuel-gas cylinders or combustible materials (especially oil or grease), a minimum distance of 20 feet (6.1 m) or by a noncombustible barrier at least 5 feet (1.5 m) high having a fire-resistance rating of at least one-half hour.
Torches: Torch Operation. Connections shall be checked for leaks after assembly and before lighting the torch. Flames shall not be used. Before lighting the torch for the first time each day, hoses shall be purged individually. Hoses shall not be purged into confined spaces or near ignition sources. Hoses shall be purged after a cylinder change.

Torch lighting: Torches shall be lighted by a friction lighter or other approved device, not by matches, cigarette lighters, or welding arcs. Point the torch away from persons or combustible materials. Whenever work is suspended, Torch valves shall be closed and the gas supply shut off.

Hose and hose connections: 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 in no case less than a pressure of 300 psi (2.04 MPa). Oil-free air or an oil-free inert gas shall be used for the test. Hose showing leaks, burns, worn places, or other defects rendering it unfit for service shall be repaired or replaced. Note: Oxygen and acetylene hoses should be different colors. Red is generally used for fuel and green for oxygen. Black is generally used for inert gas and air hoses.

Electric arc welding and cutting operations: This section contains safety precautions specific to the operations of arc welding and cutting equipment. For additional specific safety requirements for Electric Arc Welding and Cutting operations, refer to OSHA standard 1910.254, Arc welding and cutting.

Standard machines for arc welding: Arc Welding Machines shall be designed and constructed to carry their rated load with rated temperature rises where the temperature of the cooling air does not exceed 40 deg. C. (104 deg. F.) and where the altitude does not exceed 3,300 feet (1,005.8 m), and shall be suitable for operation in atmospheres containing gases, dust, and light rays produced by the welding arc.

Manual electrode holders: 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 may be used. All current carrying parts of the holder that are gripped by the welder or cutter, and the outer jaws of the holder, shall be fully insulated against the maximum voltage encountered to ground.

Welding cables and connectors: Cables shall be completely insulated, flexible, capable of handling the maximum current requirements of the work in progress, and in good repair.

Voltage: The following limits shall not be exceeded:

- Alternating-current machines: Manual arc welding and cutting – 80 volts.
- Automatic (machine or mechanized) arc welding and cutting – 100 volts.
- Direct-current machines: Manual arc welding and cutting – 100 volts.
- Automatic (machine or mechanized) arc welding and cutting – 100 volts.

When special welding and cutting processes require values of open circuit voltages higher than the above, means shall be provided to prevent the operator from making accidental contact with the high voltage by adequate insulation or other means.

For alternating current (AC) welding under wet conditions or warm surroundings where perspiration is a factor, the use of reliable automatic controls for reducing no load voltage is recommended to reduce the shock hazard.

Grounding: The frames of arc welding and cutting machines shall be adequately grounded in accordance with the manufacture, OSHA electrical standards, and ANSI standards.

Equipment loading: Care shall be taken in applying arc welding equipment to ensure that the ampere rating chosen is adequate to handle the job. Welding machines shall not be operated above the ampere ratings and corresponding rated duty cycles as specified by the manufacturer and shall not be used for applications other than those specified by the manufacturer.

Environmental conditions: When using alternating current (ac) or direct current (dc) arc welding machines, the welding operator shall take special care to prevent electrical shock. The manufacturer shall be consulted and a hazard assessment shall be performed before unusual service conditions are encountered. Unusual service conditions may exist, and in such circumstances machines shall be especially designed to safely meet the requirements of the service. Chief among these conditions are:

- Exposure to unusually corrosive fumes.
- Exposure to steam or excessive humidity.
- Exposure to excessive oil vapor.
- Exposure to flammable gases.
- Exposure to abnormal vibration or shock.
- Exposure to excessive dust.
- Exposure to weather.

Note: Water or perspiration may cause electrically hazardous conditions. Electrical shock may be prevented by performing a hazard assessment before work, relocating work to a safe location, avoiding contact with live electrical parts, and lastly by use of personal protective equipment the use of nonconductive gloves, clothing, and shoes. Other examples of electrically hazardous conditions are locations in which the freedom of movement is restricted so that the operator is forced to perform the work in a cramped (kneeling, sitting, lying) position with physical contact with conductive parts, and locations that are fully or partially limited by conductive elements and in which there is a high risk of unavoidable or accidental contact by the operator. These hazards can be minimized by performing a hazard assessment before work is performed and by insulating conductive parts near the vicinity of the operator.