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SAF-381 WELDING, CUTTING AND BRAZING PROGRAM

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1.0 Introduction

1.1 Purpose

This program provides the minimum safety requirements for welding, cutting, and brazing operations at Emory, in accordance with 29 CFR 1910.252 of the Occupational Safety and Health Administration (OSHA). This policy is intended to prevent any fires that may result from “hot work” processes and protect life and property from fire hazards and atmospheric contaminants that may occur during welding, cutting, and brazing job activities. While some entities and/or divisions of Emory may have additional or more stringent guidelines, the guidelines outlined in this document shall serve as the minimum requirements for all.

1.2 Scope

This program applies to all Emory employees, including Emory Healthcare (EHC), faculty, staff, students, and contractors who may perform welding, cutting, or brazing at Emory.

1.3 Definitions

Confined Space. A space that (1) is large enough and so configured that an employee can bodily enter and perform assigned work; and (2) had limited or restricted means for entry or exit (for example, tanks, vessels, silos, boilers, storage bins, vaults, and pits) and; (3) is not designated for continuous employee occupancy.

Fire Watch. A designated person who stands guard and is trained to *either* extinguish fires or sound the alarm.

Hot Work. Any temporary operation involving open flames or producing heat and/or sparks. Such operations include but are not limited to brazing, open-flame soldering, oxygen cutting, grinding, arc welding, cutting, thawing, oxy-fuel gas welding, hot taps, and torch applied roofing.

Hot Work Permit. A written permit that delegates the necessary precautions set forth by the authorized person who inspects the conditions of the area where hot work is to be performed.

1.4 Responsibilities

Environmental Health and Safety Office (EHSO)

As the administrative department for the Welding, Cutting, and Brazing Program, EHSO and Fire Safety, and applicable hospital/clinic safety management groups are responsible for the following in their areas:

- Providing safety information, training, and consultation to employees as needed;
- Reporting any questionable or hazardous conditions or practices that are discovered to the responsible department;
- Periodically inspecting designated areas to ensure conditions have not become unsafe for welding or cutting;
- Suspend welding, cutting, and brazing operations if conditions become unsafe for the work being performed;
- Establish designated areas for cutting and welding, and establish procedures

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for cutting and welding in other areas;

- Reviewing, updating, and evaluating the overall effectiveness of the Welding, Cutting, and Brazing Program.

Directors, Managers, and Supervisors***Managers***

Managers are responsible for:

- Management and supervisors have specific responsibility for the management and enforcement of this program in their areas.
- Management has the overall responsibility for the safe usage of cutting and welding equipment at Emory. They or their designee must:
- Designate an individual responsible for authorizing cutting and welding operations in areas not specifically designed for such processes;
- Ensure that cutters or welders and their supervisors are suitably trained in the safe operation of their equipment and the safe use of the process.

Supervisors

Supervisors are responsible for:

- Ensuring that employees are trained in safe handling and use of the cutting or welding.
- Determining the combustible materials and hazardous areas present or likely to be present in the work location.
- Advising all contractors about flammable materials or hazardous conditions of which they may not be aware.
 - Protecting combustibles from ignition by the following:
 - Ensure the work is moved to a location free from dangerous combustibles.
 - If the work cannot be moved, have the combustibles moved to a safe distance from the work or have the combustibles properly shielded against ignition.
 - See that cutting and welding are so scheduled that any operations that might expose combustibles to ignition are not started during cutting or welding.
- Obtaining hot work permits for work under their supervision.
- Determining that fire protection and extinguishing equipment are properly located at the site.
- Where fire watches are required, ensuring that they are available at the site.

Employees

Employees are responsible for complying with the rules set forth by this program.

Employees must:

- Complete Hot Work training as required by FM Global;
- Ensure that all personal protective equipment (PPE) is worn properly for the specific hazard involved and that all equipment is in good working condition;
- Conduct hot work activities in accordance with all safety guidelines and procedures;
- Protect nearby personnel against heat, sparks, radiant light, etc. when working in occupied areas; and

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- Inform their supervisors of any hazards that they feel are not adequately addressed in the workplace and of any concerns that they have regarding the program.

2.0 General Requirements

2.1 Designated Hot Work Areas

- Perform all hot work in a designated hot work area, if possible.
- A designated hot work area must be approved by EHSO, Fire Safety, or the applicable hospital/clinic Safety Management Group and meet the following requirements:
 - Constructed of noncombustible walls or curtains;
 - Have adequate ventilation, such as a suction hood system providing 20 air changes per hour;
 - Floors kept free of combustibles within 35 feet of the work area
 - At least one fire extinguisher within access of the work area.
- Hot work in areas that are not designated as hot work areas must comply with the following:
 - A Hot Work Permit is required.
 - Flammable materials that cannot be removed from the area must be adequately covered or guarded before hot work is started.
 - A fire watch must be appointed to the area.

2.2 Hot Work Permits

- A hot work permit is:
 - Required for any hot work performed outside of pre-designated hot work areas.
 - Issued by a management designated person authorized to inspect areas for hot work approval.
 - Obtained by the supervisor before the start of any hot work outside of designated areas.
- A hot work permit must:
 - Remain onsite for the duration of the job and the required time the fire watch remains.
 - Be returned to the issuing authorized person at the completion of the job.

2.3 Fire Prevention and Protection

- Prior to welding, move the object to be welded to a safe location away from combustibles;
- If the object to be welded or cut cannot readily be moved, move all moveable fire hazards in the vicinity to a safe location;
- If the object to be welded or cut cannot be moved and if all the fire hazards cannot be removed, use guards to confine the heat, sparks, and slag, and protect immovable fire hazards and designate a fire watch;
- If the requirements listed above cannot be followed, then welding and cutting cannot be performed.
- Wherever there are floor openings or cracks in the flooring that cannot be closed, take precautions to ensure that no readily combustible materials on the

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floor below will be exposed to sparks which might drop through the floor. Observe the same precautions with regard to cracks or holes in walls, open doorways and open or broken windows.

- Maintain suitable fire extinguishing equipment in a state of readiness for instant use. Such equipment may consist of pails of water, buckets of sand, hose or portable extinguishers depending upon the nature and quantity of the combustible material exposed.

2.4 Fire Watch

- A fire watch shall be required whenever welding or cutting is performed in locations where other than a minor fire might develop, or any of the following conditions exist:
 - There is an appreciable amount of combustible material, in building construction or contents, closer than 35 feet to the point of operation;
 - There is an appreciable amount of combustible materials more than 35 feet away but they are easily ignited by sparks;
 - There are wall and floor openings within a 35 feet radius which might expose combustible material in adjacent areas to hot work, including concealed spaces in walls and floors; and
 - There are combustible materials adjacent to the opposite side of metal partitions, walls, ceilings, or roofs and are likely to be ignited by the conduction or radiation of heat.
- The fire watchers are required to do the following:
 - Ensure fire extinguishing equipment is readily available and be trained in its use.
 - Be familiar with facilities for sounding an alarm in the event of a fire.
 - Watch for fires in all exposed areas, try to extinguish them only when obviously within the capacity of the equipment available, or otherwise sound the alarm.
 - Maintain a fire watch for at least an hour at the site and perform periodic checks for an additional three hours after completion of welding or cutting operations to detect and extinguish possible smoldering fires.

2.5 Prohibited Hot Work Areas

- Welding and cutting are not permitted in the following areas:
 - Areas not authorized by management;
 - Areas equipped with sprinkler systems that are inoperable at the time of the hot work;
 - Areas where appropriate firefighting equipment is not readily available;
 - In the presence of potentially explosive atmospheres (e.g., inside uncleaned or improperly prepared tanks or equipment which have previously flammable liquids, or in areas with an accumulation of combustible dust may be present);
 - Areas where floor and wall openings cannot be covered;
 - Areas where combustible or flammable materials are within 35 feet and cannot be moved.

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3.0 Protection of Personnel

3.1 General

- Ensure that welders or helpers working on platforms, scaffolds, or runways are protected against falling. This may be accomplished by the use of railings, safety harnesses, life lines, or some other equally effective safeguards.
- Place welding cables and other equipment so that it is clear of passageways, ladders and stairways.

3.2 Eye and Face Protection

Selection

- Use helmets or hand shields during all arc welding or arc cutting operations, excluding submerged arc welding. Provide helpers and attendants with proper eye protection.
- Use goggles or other suitable eye protection during all gas welding or oxygen cutting operations. Spectacles without side shields but with suitable filter lenses are permitted for use during gas welding operations on light work, for torch brazing or for inspection.
- All operators and attendants of resistance welding or resistance brazing equipment must use transparent face shields or goggles, depending on the particular job, to protect their face and eyes, as required.
- Provide eye protection in the form of suitable goggles where needed for brazing operations not covered under Section 3.2.

Specifications of protectors

- Ensure helmets and shields are made of a material that is an insulator from heat and electricity. Helmets, shields and goggles cannot be readily flammable and must be capable of withstanding sanitization.
- Arrange helmets and hand shields in such a manner to protect the face, neck, and ears from the arc's direct radiant energy.
- Ensure helmets have filter plates and cover plates designed for easy removal.
- All parts must be made of a material that does not readily corrode or discolor the skin.
- Use goggles that are ventilated to prevent fogging of the lenses as much as practicable.
- All glass for lenses must be tempered, substantially free from striae, air bubbles, waves and other flaws. Except for corrective lenses, the front and rear surfaces of lenses shall be smooth and parallel.
- Lenses shall bear some permanent distinctive marking by which the source and shade may be readily identified.
- Table 1.0 is a guide for the selection of the proper shade numbers. These recommendations may be varied to suit the individual's need.

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Table 1.0 – Shade Number Selection Guidance

Welding Operations	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
Shielded metal-arc welding 5/16, 3/8-inch electrodes	14
Atomic Hydrogen Welding	10-14
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, use a filter or lens that absorbs the yellow light.

3.3 Respiratory Protection

- Engineering controls and safe work practices are the primary means to prevent employee over exposure to welding fumes, toxic gases, and dusts;
- Contact EHSO at 404-727-5922 to conduct welding assessments.

3.4 Protective Clothing

- Provide employees that are exposed to the hazards created by welding, cutting and brazing operations with personal protective equipment (PPE) that is suitable for the type of work being performed.
- Maintain PPE in good repair and keep it free of oil and grease.
- Keep sleeves rolled down and buttoned at the wrist.
- Keep collars buttoned.
- Wear fire-resistant gloves and aprons during welding, flame cutting and brazing

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processes.

3.5 Work in Confined Spaces

- **Ensure adequate ventilation.** Ventilation is a prerequisite to work in confined spaces. For ventilation requirements see Section 4.2 of this program.
- **Secure cylinders and machinery.** When performing welding or cutting in any confined spaces the gas cylinders and welding machines must be left on the outside. Before operations are started, securely block any heavy portable equipment that is mounted on wheels to prevent accidental movement.
- **Use lifelines.** Where a welder must enter a confined space through a manhole or other small opening, means shall be provided for quickly removing him in case of emergency. When safety belts and lifelines are used for this purpose they must be so attached to the welder's body that his body cannot be jammed in a small exit opening. An attendant with a preplanned rescue procedure must be stationed outside to observe the welder at all times and be capable of putting rescue operations into effect.
- **Remove electrodes.** When arc welding is to be suspended for any substantial period of time, such as during lunch or overnight, remove all electrodes from the holders and carefully locate the holders so that accidental contact cannot occur and disconnect the machine from the power source.
- **Close torch valves and shutoff gas cylinder.** To prevent accidental gas leakage, close the torch valves and shut off the fuel-gas and oxygen supply to the torch outside the confined space whenever the torch is not to be used for a substantial period of time, such as during lunch hour or overnight. Where practicable remove the torch and hose from the confined space.
- **Mark hot metal with warning sign.** After welding operations are completed, the mark the hot metal or provide some other means of warning other workers.

4.0 Health Protection and Ventilation

4.1 General

- Contamination. The requirements in this section have been established on the basis of the following three factors in arc and gas welding which govern the amount of contamination to which welders may be exposed:
 - Dimensions of space in which welding is to be done (with special regard to height of ceiling);
 - Number of welders; and
 - Possible evolution of hazardous fumes, gases, or dust according to the metals involved.
- When welding must be performed in a space entirely screened on all sides, arrange the screens so that no serious restriction of ventilation exists. It is desirable to have the screens so mounted that they are about 2 feet (0.61 m) above the floor unless the work is performed at so low a level that the screen must be extended nearer to the floor to protect nearby workers from the glare of welding.
- Provide local exhaust or general ventilating systems to keep the amount of toxic fumes, gases, or dusts below the maximum allowable concentration.
- All potentially hazardous materials employed in fluxes, coatings, coverings, and

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filler metals must be included on the chemical inventory of the area in accordance with Emory's Hazard Communication Program. Potentially hazardous materials include but are not limited to the materials itemized in Sections 4.5 through 4.12 of this program.

4.2 Ventilation for General Welding and Cutting

- Provide mechanical ventilation when welding or cutting is done on metals not covered in sections 4.5 through 4.12 of this program and:
 - In a space of less than 10,000 cubic feet per welder.
 - In a room having a ceiling height of less than 16 feet.
 - In confined spaces or where the welding space contains partitions, balconies, or other structural barriers to the extent that they significantly obstruct cross ventilation.
- Ensure ventilation is at the minimum rate of 2,000 cubic feet per minute per welder, except where local exhaust hoods and booths or airline respirators are provided.
- Natural ventilation is considered sufficient for welding or cutting operations where the restrictions in this section of this program are not present.

4.3 Local Exhaust Booths and Hoods

Mechanical local exhaust ventilation may be by means of either of the following:

- Freely movable hoods intended to be placed by the welder as near as practicable to the work being welded and provided with a rate of air-flow sufficient to maintain a velocity in the direction of the hood of 100 linear feet per minute in the zone of welding when the hood is at its most remote distance from the point of welding. The rates of ventilation required to accomplish this control velocity using a 3-inch wide flanged suction opening are shown in Table 2.0.
- A fixed enclosure with a top and not less than two sides which surround the welding or cutting operations and with a rate of airflow sufficient to maintain a velocity away from the welder of not less than 100 linear feet per minute.

Table 2.0 – Rates of Ventilation

Welding Zone	Minimum air flow ¹ cubic feet/minute	Duct Diameter inches ²
4 to 6 inches from arc or torch	150	3
6 to 8 inches from arc or torch	275	3 ½
8 to 10 inches from arc or torch	425	4 ½
10 to 12 inches from arc or torch	600	5 ½

¹ When brazing with cadmium bearing materials or when cutting on such materials increased rates of ventilation may be required.

² Nearest half-inch duct diameter based on 4,000 feet per minute velocity in pipe.

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4.4 Ventilation in Confined Space

- All welding and cutting operations carried on in confined spaces shall be adequately ventilated to prevent the accumulation of toxic materials or possible oxygen deficiency. This applies not only to the welder but also to helpers and other personnel in the immediate vicinity. All air replacing that withdrawn shall be clean and respirable.
- In circumstances for which it is impossible to provide such ventilation, airline respirators or hose masks approved for this purpose by the National Institute for Occupational Safety and Health (NIOSH) under 42 CFR part 84 must be used.
- In areas immediately dangerous to life and health, a full-facepiece, pressure-demand, self-contained breathing apparatus or a combination full-facepiece, pressure-demand supplied-air respirator with an auxiliary, self-contained air supply approved by NIOSH under 42 CFR part 84 must be used.
- Where welding operations are carried on in confined spaces and where welders and helpers are provided with hose masks, hose masks with blowers or self-contained breathing equipment approved by the Mine Safety and Health Administration and the National Institute for Occupational Safety and Health, a worker shall be stationed on the outside of such confined spaces to insure the safety of those working within.
- Oxygen shall **never** be used for ventilation.

4.5 Flourine Compounds

- In confined spaces, welding or cutting involving fluxes, coverings, or other materials which contain fluorine compounds shall be done in accordance with this section. A fluorine compound is one that contains fluorine, as an element in chemical combination, not as a free gas.
- Maximum allowable concentration. The need for local exhaust ventilation or airline respirators for welding or cutting in other than confined spaces will depend upon the individual circumstances. However, experience has shown such protection to be desirable for fixed-location production welding and for all production welding on stainless steels. Where air samples taken at the welding location indicate that the fluorides liberated are below the maximum allowable concentration, such protection is not necessary.

4.6 Zinc

- In confined spaces welding or cutting involving zinc-bearing base or filler metals or metals coated with zinc-bearing materials shall be done in accordance with this section.
- In indoor settings, welding or cutting involving zinc-bearing base or filler metals coated with zinc-bearing materials shall be done in accordance with section 4.0. of this program

4.7 Lead

- In confined spaces, welding involving lead-base metals (erroneously called lead-burning) shall be done in accordance with section 4.4 of this program.
- In indoor settings, welding involving lead-base metals shall be done in accordance with section 4.0 of this program.

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- In confined spaces or indoors, welding or cutting operations involving metals containing lead, other than as an impurity, or metals coated with lead-bearing materials, including paint, must be done using local exhaust ventilation or airline respirators. Such operations, when done outdoors, must be done using respirators approved for this purpose by NIOSH under 42 CFR part 84. In all cases, workers in the immediate vicinity of the cutting operation must be protected by local exhaust ventilation or airline respirators.

4.8 Beryllium

- Welding or cutting indoors, outdoors, or in confined spaces involving beryllium-containing base or filler metals shall be done using local exhaust ventilation and airline respirators unless atmospheric tests under the most adverse conditions have established that the workers' exposure is within the acceptable concentrations defined by 1910.1000 of this part.
- In all cases, workers in the immediate vicinity of the welding or cutting operations shall be protected as necessary by local exhaust ventilation or airline respirators.

4.9 Cadmium

- In confined spaces or indoors, welding or cutting operations involving cadmium-bearing or cadmium-coated base metals must be done using local exhaust ventilation or airline respirators unless atmospheric tests under the most adverse conditions show that employee exposure is within the acceptable concentrations specified by 29 CFR 1910.1000. Such operations, when done outdoors, must be done using respirators, such as fume respirators, approved for this purpose by NIOSH under 42 CFR part 84.
- Welding (brazing) involving cadmium-bearing filler metals shall be done using ventilation as prescribed in section 4.3 or 4.4 of this program if the work is to be done in a confined space.

4.10 Mercury

In confined spaces or indoors, welding or cutting operations involving metals coated with mercury-bearing materials, including paint, must be done using local exhaust ventilation or airline respirators unless atmospheric tests under the most adverse conditions show that employee exposure is within the acceptable concentrations specified by 29 CFR 1910.1000. Such operations, when done outdoors, must be done using respirators approved for this purpose by NIOSH under 42 CFR part 84.

4.11 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.

4.12 Cleaning Compounds

- In the use of cleaning materials, because of their possible toxicity or flammability, appropriate precautions such as manufacturer's instructions shall be followed.
- Degreasing and other cleaning operations involving chlorinated hydrocarbons

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shall be so located that no vapors from these operations will reach or be drawn into the atmosphere surrounding any welding operation. In addition, trichloroethylene and perchloroethylene should be kept out of atmospheres penetrated by the ultraviolet radiation of gas-shielded welding operations.

4.13 First Aid Equipment

Ensure first-aid equipment is available at all times. Report all injuries as soon as possible for medical attention. First aid shall be rendered until medical attention can be provided.

5.0 References

[OSHA Welding, Cutting, and Brazing – 29 CFR 1910.252 Subpart Q](#)

[OSHA Personal Protective Equipment – 29 CFR 1910.132 Subpart I](#)