1. PURPOSE

This policy is to ensure WFU 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."

2. RESPONSIBILITIES

A. Environmental, Health, and 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.

B. Supervisor

Supervisors are responsible in making sure employees who will be performing Hot Work operations are properly trained on the WFU procedures before performing work on campus. A 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 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: individual qualified and authorized by management to perform hot work such as welding, brazing, soldering, and other associated work tasks.
• Permit Authorizing Individual: individual trained and authorized to issue a hot work permit by management.
• Fire Watch: individual trained in hot work safety and monitoring the hot work area for changing conditions, watching for fires and extinguishing them, if possible.

C. Employee

Employee performing hot work SHALL:

• Before use of welding equipment, read and understand all safety practices outlined in the manufacturer instruction manual for the specific type(s) of welding equipment used for the work process. Read and understand Safety Data Sheets (SDSs) for any compressed gases or other chemical products and safety requirements of this policy.
• Employee performing hot work, fire watches, and supervisors of hot work operations must complete annual Fire Safety Training ("hands on") and complete the annual online OSHA training located on the EHS website – Training.
• Inspect all welding equipment 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 welding personal protective equipment (PPE) for the specific job.

3. Hazard Identification and Prevention

A. 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 the work 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 immediate 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 vapors when heated.
• Provide safety supervision for outside contractors conducting hot work. Inform contractors about site-specific hazards including the presence of flammable materials.

B. Hot Work Permit Requirements

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

The PAI 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. The PAI then shall inspect the work area and confirm that precautions have been taken to prevent a fire. The PAI 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 needed during work 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. The PAI must inspect if hot work is planned near or on walls, ceiling, 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. The PAI must ensure that the Fire Watch is provided during hot work and for at least 30 minutes after the completion of hot work.
10. The PAI 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. The PAI 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 completion of hot work 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 the Environmental, Health, and Safety Department via campus mail (attention: EHS) or hand delivered.

C. 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 Utilities Shop or basement of UOC 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 a campus building construction area where welding must take place and the work area has been made safe.

- In a Controlled Area, a Hot Work Permit must be obtained by the hot work operator.
- The permit must be obtained from the Supervisor or designated Permit Authorizing Individual (PAI) before the hot work can proceed in a controlled area.
- Refer to the next page of this policy for the WFU Hot Work Permit that is to be used before commencing hot work activities.
Non-Permissible Locations
A location that cannot be made safe for hot work. *Hot work is not permitted in these locations. An example is near closed tanks, vessels or containers that contain or have contained flammable liquids such as a fuel tank or solvent drum.

D. Welding and Hot Work – In and Around Tanks

WFU 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 (PAI or EHS staff). Assistance can be obtained with atmospheric monitoring by contacting EHS Department at 336-758-3427.
- If any detectable readings are obtained, then work cannot begin or continue until the source of vapor is found and suitable mitigated such that the concentration is maintained below 10% of the Lower Flammable/Explosive Limit. For technical assistance regarding combustible gas meters, contact EHS Department at 336-758-3427.

E. Electric Shock Hazards and Safety Precautions

Electric shock from electrical welding and cutting equipment can result in electrocution (death) or severe burns. Additionally, serious injury can occur if the welder falls as a result 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 at all times 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 measure 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, using DC constant voltage wire welder is recommended. And do not work alone!

F. Ventilation Required 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.

4. 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.

A. 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. Keep clothing clean (free of oil, grease, or solvents which may catch fire and burn easily). Change it when needed (this reduces the possibility of electric shock). 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.

B. Foot and Leg Protection

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.

C. 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.

D. 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.

E. Respiratory Protective Equipment

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 must first be enrolled in, and meet the requirements of the University Respiratory Protection Program, administered by the EHS Department.

F. 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. For Oxy-fuel 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 oxy-fuel gas welding and cutting operations.

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.

7. Approved Fire Resistant Materials for Hot Work Areas

A. Welding Blanket

A heat-resistant fabric designed to be placed in the vicinity of 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.

B. 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.

C. 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.

*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.
8. REVISIONS

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