

## Welding, Burning, and Cutting Program

Responsible Administrator: EH&S Safety Specialist  
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**Summary:** This section outlines the policy and procedures related to the Welding, Burning, and Cutting Program that is administered through the Environmental Health & Safety (EH&S) Department.

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### 1. Program Description

This program details the process required to obtain and complete a hot work permit to perform hot work (welding, burning, and cutting) activities at the UC Irvine campus and facilities. These procedures have been established to prevent accidental fires, loss of life, injury from exposure to sparks, heat, or flames, and/or property loss. The hazards associated with hot work can be reduced through the implementation of an effective control program.

The purpose of this program is to provide guidelines for open flame activities and to establish a permit process for these activities on campus. The intention of this program is to create a self-policing system of safe work practice verification.

### 2. Scope

2.1 The scope of this program covers all hot work activities performed by UC Irvine employees and other employees who are under the supervision and direction of UC Irvine employees. This includes Facilities Management (FM) employees, individual department renovations and construction personnel, and outside contractor personnel.

Designated and fixed welding stations located throughout campus are listed in Appendix A.

2.2 A Hot Work Permit is required for all work under the following conditions:

Area/Job Title	Operation(s)
<b>Non-Construction &amp; Renovation Activities (Facilities Management &amp; other Departments)</b>	
HVAC Maintenance Engineers	Welding, cutting, brazing, and soldering on refrigerant lines; replacement and installation of compressors and valves

Central Plant	Cutting, grinding, and brazing activities; high pressure pipe welding on steam pipes, feed pipes, phalanges and fittings; black iron pipe welding
Plumbing Shop	Welding, cutting, brazing, and soldering on plumbing fixtures and copper lines; sweating pipes and valves
Sheet Metal Shop	Pipe welding, metal fabrication, structural welding
Maintenance employees within individual Student Housing complexes	Brazing and soldering plumbing fixtures; sweating pipes and valves
Facilities Management Machine Shops	Grinding, welding, cutting, brazing and Torch Soldering
Asbestos abatement projects throughout campus	Torch used to replace and install floor tiles

Area/Job Title New Construction & Renovation Activities (Design and Construction Services)	Operation(s)
All activities listed in Title 8 California Code of Regulations (8CCR) and specific permit conditions listed in the California Fire Code (CFC) Article 49	Brazing, soldering, arc welding, grinding, cutting, and burning

### 3. Definitions

**Brazing and Soldering** – Soldering and brazing uses molten metal to join two pieces of metal. The metal added during both processes has a melting point lower than that of the work piece, so only the added metal is melted, not the work piece. Brazing produces a stronger joint than does soldering, and often is used to join metals other than steel, such as brass. Brazing can also be used to apply coatings to parts to reduce wear and protect against corrosion.

**Combustible Materials** – Solid materials that are capable of burning and igniting.

**Confined Space** – A space that has all of the following characteristics:

1. It is large enough and so configured that a person can bodily enter; and
2. It has limited or restricted means for entry or exit; and
3. It is not designed for continuous occupancy.

Confined spaces can be classified into two categories:

- Low-hazard non-permit required confined space; and
- High-hazard permit-required confined space

Low-hazard confined spaces are those confined spaces that do not contain or have the potential to contain any atmospheric or other hazards capable of causing death or serious physical harm. A low-hazard confined space may become a high-hazard confined space if there are hazardous materials brought into the space or if hazardous activities (such as welding, brazing, or cutting) are conducted in the space.

Permit-required confined spaces are those spaces that contain high hazards and are based on their inherent hazard potential. For a high-hazard permit-required confined space, an entry permit is used to ensure proper hazard evaluation, safe entry, safe work and safe exit. See Section 5.4 for additional information on confined spaces.

**Cutting** – Any process, including grinding, which produces sparks capable of igniting combustible or flammable materials and transmits heat to the work material from a hot gas.

**Designated Campus Fire Marshal (DCFM)** – At the UC Irvine campus, the State Fire Marshal's office has delegated the Designated Campus Fire Marshal as the Authority Having Jurisdiction for plan review and construction inspections. The DCFM also has the responsibility and authority to enforce State Fire Marshal regulations and requirements on campus.

**Fire Watch for Welding Activities** – At least one individual dedicated *solely* to the look out and control of stray fires.

**Flammable Compressed Gas** - Flammable compressed gases have dangers besides high pressure. These gases can easily catch fire and burn rapidly. These include acetylene, hydrogen, natural gas and propane.

**Flammable Materials** – Solid or liquid materials that are capable of igniting at a low temperature and continuing to burn.

**Grinding** – See the definition for Cutting.

**Hot Work** – Operations such as welding, cutting, burning, heating, grinding, or similar spark, slag, or intense heat producing activities that are capable of igniting combustible materials or flammable atmospheres or providing a source of ignition for a fire. Also defined as cutting and welding operations for construction/demolition activities that involve the use of portable gas or arc welding equipment, open flame or spark-producing apparatus.

**Hot Work Permit** – A hot work permit is the means by which EH&S can stay aware and keep track of construction and all other activities that involve hot work. The hot work permit also provides a step-by-step checklist for hot work fire safety and serves as a reminder to contractors of their fire prevention responsibilities before, during, and after any hot work is conducted. The permit system is intended to educate the parties involved in construction of these hazards to implement control measures to help mitigate them.

**New Construction** – New work that is comprised of structural and mechanical work creating new buildings. The following are the types of hot work anticipated for new construction:

- Structural hot work: Cutting/welding reinforcing steel and structural steel for all of the project's structural work (tunnels construction, building super-structure, site work).
- Mechanical work: Tunnel services connections, building system installations, HVAC equipment installations.
- General activities hot work: All other cutting/welding for equipment/building component installations (handrails, guardrails, specialties, and ornamental metal) and HVAC equipment installations

**Nonflammable Compressed Gas** - These types of gases do not catch fire easily or burn quickly but will eventually burn and possess other dangers. The cylinder label and Material Safety Data Sheet (MSDS) will describe the toxic properties and physical hazards posed by specific nonflammable compressed gases. These include: ammonia, argon, carbon dioxide, nitrogen, oxygen, chlorine, and nitrous oxide. Symptoms of exposure include dizziness, unconsciousness, or suffocation under certain circumstances. They can also be harmful if inhaled, and can cause irritation to the eyes, nose, throat, and lungs.

**Renovations and Remodels** - New work that takes place in an existing building. The following are the types of hot work anticipated for renovations/remodels:

- Demolition hot work: Dismantling built-in equipment, removal of discontinued/abandoned services, new services tie-ins, building system installations/modifications.
- Mechanical hot work: Removal of discontinued/abandoned services, new services tie-ins, building system installation/modifications.
- General hot work activities: All other cutting/welding for equipment/building component installations (handrails, guardrails, specialties, and ornamental metal).

**Shielding** – Non-combustible welding drapes, used in hot work areas. Visible signs should be displayed on shielding while hot work is being performed.

**Smoldering** – A slow combustion of material without visible light and generally evidenced by smoke and an increase in temperature.

**Soldering** - Soldering uses metals with a melting point below 800 degrees Fahrenheit. Soldering is commonly used to join electrical, electronic, and other small metal parts.

**Thawing Pipe** – Devices for thawing the frozen fluid in pipes or pipes having the means for preventing the fluid from freezing or the pipe from bursting when the fluid freezes.

**Torch Operations** – A plasma torch is used as an advanced tool for welding and cutting operations. Intense ultraviolet radiation, high noise levels, and gases are generated during this process.

**Welding** – Welding is the most common way of permanently joining metal parts. In this process, heat is applied to metal pieces, melting, and fusing them to form a permanent bond. The following lists the most practiced forms of welding:

- Oxygen-Fuel Gas Welding – The act of joining metal by generating extremely high heat during combustion.
- Resistance Welding –The act of joining or cutting metals by generating heat through resistance created by the flow of an electric current.
- Arc Welding –The act of joining or cutting metals by generating heat from an electric arc that extends between the welding electrode and the electrode placed on the equipment being welded.
- Gas Tungsten Arc (TIG) welding is often used with stainless steel or aluminum. TIG uses welding rods, where the welder holds the welding rod in one hand and an electric torch in the other hand. The torch is used to simultaneously melt the rod and the work piece.
- Gas Metal Arc (MIG) welding uses a spool of continuously fed wire, which allows the welder to join longer stretches of metal without stopping to replace the rod. The welder holds the wire feeder which functions like the alligator clip in arc welding. Instead of using gas flux surrounding the rod, TIG and MIG protect the initial weld from the environment by blowing inert gas onto the weld.

#### 4. Responsibilities

##### 4.1 UC Irvine Employees

- Follow all warning signs, barricades, and barriers posted around hot work activities; and
- Immediately report any signs of smoldering flames.

##### 4.2 Design and Construction Services (D&CS)

- For new construction activities and renovation projects, assist EH&S in the intent of this program;

- Complete required hot work permit request form when necessary;
- Ensure that all contractors (both general and sub) post permits for the duration of the hot work;
- Provide copy of contractor's hot work or welding safety program to the Designated Campus Fire Marshal/Fire Safety Division for their review;
- Ensure that fire protection and extinguishing equipment is available at the site at least 48 hours before starting the job;
- Ensure that the contractor is performing the required minimum fire watch; and
- Maintain documentation of current and cancelled permits.

#### 4.2.1 Inspector of Record (IOR) Responsibilities

- Attend required initial and refresher Welding Safety training. See Section Seven for training requirements;
- Ensure that all contractors (both general and sub) post permits for the duration of the hot work;
- Ensure that fire protection and extinguishing equipment is available at the site at least 48 hours before starting the job; and
- Ensure that the contractor is performing the required minimum fire watch.

#### 4.3 All other Departments, including Facilities Management (FM), Student Housing, Student Center, Anteater Recreation Center (ARC), Research and laboratory environments, etc.

- Assist EH&S in the intent of this program;
- Attend required initial and refresher Welding Safety training. See Section Seven for training requirements;
- Ensure that workers performing hot work are trained and know the procedures that apply to the specific work or task being performed;
- Complete required hot work permit request form and obtain permit before initiating work;
- Ensure that the fire protection system within buildings is available at the site at least 48 hours before starting the job; Post permits for the duration of the hot work;
- Be responsible for the safe handling and use of heating, cutting, welding, or grinding equipment;
- Review the work location to determine if combustible materials, hazardous atmospheres, or hazardous materials are present in the work area;
- Ensure that equipment used is in proper working condition; Ensure that a Fire Watch has been assigned (See Section 4.4); Maintain documentation of current and cancelled permits;
- Work areas where hot work is performed on a continual or on-going basis may be permitted for this work on a yearly basis. These designated fixed hot work areas must be maintained free of combustible materials at all times, and must be inspected periodically to assure that the area is safe for hot work to continue; and
- Use appropriate PPE while performing hot work (welding helmets, gloves, jackets, etc...).

#### 4.4 Fire Watch for Welding Activities

- The Fire Watch may only be performed by an individual who is not performing any other duties that would take attention away from the area where the hot work is performed;
- Be aware of the inherent hazards involved in hot work;
- Ensure that safe conditions are maintained during the hot work;
- Ensure that appropriate fire extinguishers are readily available at the job site; Know how to report a fire or other emergency situation;
- Using appropriate Personal Protective Equipment (PPE). Refer to EH&S Personal Protective Equipment Program at: [https://www.ehs.uci.edu/programs/\\_pdf/safety/ppe-program.pdf](https://www.ehs.uci.edu/programs/_pdf/safety/ppe-program.pdf);

- Return the completed hot work permit to file;
- Ensure that any covers from sprinkler heads are immediately removed upon completion of the hot work. Sprinkler heads cannot be covered after work hours and must be removed. Refer to Section 5.8 for additional procedures on Isolation of Fire Detection Systems;
- Be trained in campus fire safety procedures and the use of fire extinguishing equipment; Have access to at least a ten (10) pound ABC fire extinguisher at all times;
- Must remain in a location that allows immediate communication with the individual(s) performing hot work; Be familiar with the surrounding facilities to sound an alarm in the event of a fire;
- Have means of emergency communication to UC Irvine Police Department;
- Watch for fires in all exposed areas for a minimum of sixty (60) minutes (including lunch and break times), sound the alarm if necessary, and try to extinguish fires only when obviously within the capability of the equipment available;
- Ensure that no condition arises, or action is taken, that will lead to a hazardous situation in the hot work area; and
- Must remain in the work area after work is completed to ensure the risk of fire from hot work has passed (minimum of sixty (60) minutes).

#### 4.5 Designated Campus Fire Marshal (DCFM)

- Review and approve all hot work permits for all hot work activities for all new construction and renovation activities occurring on campus;
- Stop hot work activities that do not have a proper permit on display;
- Serve as a technical resource for fire prevention issues; and
- Contact lead person or supervisor to obtain more specific information about hot work activities, or visit the work site, as deemed necessary.

#### 4.6 Environmental Health and Safety (EH&S)/Safety Division

- Review and approve all hot work permits for all other activities on campus, excluding construction activities;
- Contact lead or supervisor to obtain more specific information about hot work activities, or visit the work site, as deemed necessary;
- Stop hot work activities that do not have a proper permit on display;
- Audit hot work permits and procedures on a periodic basis;
- Coordinate and/or conduct welding, burning, and cutting training; and
- Serve as a technical resource for fire prevention issues.

### 5. Program Components

#### 5.1 How to Obtain and Complete a Hot Work Permit

To expedite the hot work permit process, permit request should be submitted at least 48 hours prior to the commencement of hot work.

1. Go to the EH&S web site ( <https://www.ehs.uci.edu/> ) and click on “How Do I” link located at the top of the web page. Look under the “Request” tab and click on the “Hot Works Permit” link. Select the appropriate permit type (Facilities Management, Design and Construction Services, Other Department). An online form will appear.
2. Type in the applicable information on the form.
3. After completing the form, click the “Submit” button at the end of the page. A notice of permit submittal is then sent to either the DCFM or to EH&S for review and approval. If you are completing the permit by hand, bring the permit request form to EH&S.

4. Post the signed and approved hot work permit in the vicinity of where the hot work will be performed and for the duration of the hot work activity. Permits must be posted at the job site in an accessible and conspicuous location. Job site trailers are an acceptable location.
5. Once the hot work has been stopped, finished, or completed, perform a Fire Watch for at least thirty (60) minutes after hot work activity has been completed.
6. After the work under the permit is completed and the Fire Watch has been completed, send a copy of the completed permit to EH&S or to the DCFM and file a copy of the permit in your own department records.

5.2 Hot Work Permit will NOT be issued if the following conditions exist:

- Sprinkler protection is impaired. Contact the Facilities Management Plumbing Shop for assistance.
- Sprinklers, hose streams, and extinguishers are not in service and inoperable. Contact the Facilities Management Plumbing Shop for assistance.
- Appropriate fire extinguisher is not immediately available for use.
- Combustible or flammable materials are within thirty-five (35) feet and cannot be moved or protected from ignition sparks. An explosive atmosphere exists. Use air-monitoring equipment to determine safe levels of combustible gases and vapors.
- All wall and floor openings are open and not covered.
- Work is not covered underneath by a fire-resistive tarpaulin or similar material.
- Cutting or welding on pipes or other metals conducts enough heat to ignite combustible materials located nearby. Fire Watch personnel performing other duties.

5.3 Compressed Gas Cylinders (CGC's) - Compressed gas cylinders have inherent dangers aside from using them in hot work activities. The handling and storage of compressed gas cylinders must be undertaken with great care. A primary danger of oxygen-fuel gas welding operations stems from welding with CGC's containing oxygen and acetylene. If CGC's are damaged, gas can escape with tremendous force and the vessel itself can explode, causing severe injuries. A condition called "rocketing" can occur when a CGC ruptures and is propelled with such force that it can penetrate a concrete wall.

5.3.1 Handling – The following guidelines should be followed when working with CGC's:

- Cylinders should be secured in the upright position to prevent tipping.
- Regulators must be compatible with the cylinder and its content. Many regulators are similar in design and construction, so it is necessary to check the regulator's model number and compare it with the cylinder's requirements to ensure compatibility.
- Cylinder carts equipped with cylinder restraints such as a chain or strap should be used for transporting and while using CGC's. Never drop cylinders or let items fall on them.
- Do not accept delivery of acetylene CGC's that arrive in the horizontal position. Transporting cylinders in this manner makes them much more susceptible to explosion.
- CGC's should be inspected before using to check for leaking, corrosion, cracking, burn marks, contaminated valves, worn hoses and faulty connectors, or broken gauges. If any defective condition is discovered, the CGC should not be used.
- Never open valves until regulators are drained of gas and pressure adjusting devices are released. When opening CGC's, point outlets away from people and sources of ignition and



open valves slowly. On valves without handle wheels, use only supplier recommended wrenches. On valves with handle wheels, never use wrenches. Never use a hammer to turn a handle wheel open or closed.

- When cylinders are empty, close and return them. Empty CGC's must be marked "MT" or "Empty".

#### 5.3.2 Storage – The following guidelines should be followed when storing CGC's:

- Oxygen and fuel gas cylinders must be stored separately with protective valves in place.
- Oxygen and acetylene must be stored at least twenty (20) feet apart, and separated by a non-combustible wall at least five (5) feet in height.
- Regulators must be compatible with the CGC and designed for the appropriate cylinder.
- Check the manufacturer's model number and compare it with the gas supplier's requirements and with the gas cylinder.
- Cylinder carts must be used to transport cylinders from location to location.
- Cylinders must be secured from tipping and secured in an upright position while in use. The cylinder must be braced from tipping over by placing a strap or chain around the top third of the cylinder.
- Empty or unused gas cylinders must be promptly returned to the supplier.
- Gas cylinders and welding equipment must be left outside the work space where the work was performed. Examples of such locations include boilers, tanks, or pressure vessels.
- Heavy portable equipment mounted on wheels must be securely blocked to prevent movement.
- Protective valve caps should be in place on the CGC when it is placed into storage. This will reduce the likelihood that a blow to the valve will result in leakage.
- When stored, CGC's should be arranged in such a way that old stock will be used before new stock.

#### 5.4 Confined Spaces – When performing hot work in confined spaces, employees must comply with UC Irvine's Confined Space Entry Management Program. In addition, employees must adhere to the following guidelines:

- Keep all gas cylinders and welding machines outside of confined spaces;
- Positively isolate the gas supply outside the confined space when torches are not in use for a substantial period of time (such as during lunch). When practical, employees should remove torches and hoses from confined spaces;
- De-energize electrode holders by electronically disconnecting the power supply when arc welding is to be suspended for an appreciable amount of time or when the welder must leave the job;
- Use insulating mats or similar insulating equipment to protect welders using alternating current equipment over fifty (50) volts from electrical contact with conductive materials; and
- Ensure that available ventilation in the confined space meets the ventilation requirements as stated in Section 5.6.
- Avoid bringing hot work into non-permit required confined spaces. If hot work hazards are introduced into these spaces, the status of the space will change and a permit will be required to enter these spaces.

5.5 Engineering Controls – Ventilation should be adequate, depending on volume and configuration of space, number and type of operations that are generating contaminants, natural air flow rate where operations are taking place, location of the welding breathing zone, and whether ventilation can be obtained mechanically or naturally.

5.5.1 Ventilation and Atmospheric Testing – Ventilation techniques for welding operations vary depending on size and type. For basic operations, fans will provide enough ventilation. However,



ventilation should never be relied on as the only method of protecting employees when it is suspected that air contaminants are present. Where ventilation is poor, respirator use should be evaluated before hot work activities commence. Ventilation of the space where hot work is going to occur should be evaluated based on the guidelines provided below:

- Hot work should not be conducted in the presence of explosive mixtures of flammable gases, vapors, liquids, or dusts or where explosive mixtures could develop inside improperly prepared tanks or equipment.
- Atmospheric testing and monitoring for combustible gases and vapors must always be conducted inside a confined space before work commences and at regular and predetermined intervals thereafter. Contact EH&S for additional assistance.
- While working in poorly ventilated spaces, exposure to air contaminants generated by welding or cutting must be controlled by ventilation, respiratory protection, or by a combination of the two.

5.6 Fire Watch – A Fire Watch is required whenever welding or cutting is performed in locations where an incipient stage fire might develop, or whenever any of the following conditions exist:

- Appreciable combustible materials are closer than thirty-five (35) feet to the point of operation; Appreciable combustibles are present which can be ignited by sparks;
- Wall or floor openings within a thirty-five (35) feet radius exposure to combustible materials in adjacent areas including concealed spaces in walls or floors; or
- Combustible materials are adjacent to the opposite side of metal partitions, walls, ceilings or roofs and are likely to be ignited by conduction or radiation.

A fire watch must be maintained for a minimum of sixty (60) minutes after completion of hot work to detect and extinguish smoldering fires. Suitable fire extinguishing equipment must be maintained and be ready for use while welding, cutting, and burning activities are performed and during the fire watch.

5.7 Warning Signs, Barricades, and Barriers – In order to control traffic, barriers and proper signs must be posted to ensure traffic is prevented from exposure to hot work areas. Shields must be used to prevent exposure to sparks and flashes. A clear path to an exit of at least forty-four (44) inches must be maintained at all times. Whenever possible, vehicular traffic should be kept out of hot work areas while work is in progress.

5.8 Isolation of Fire Detection Systems – Fire detection equipment must be protected from false activation and damage. If hot work impacts the fire detection system, the FM Building Systems Technicians must be notified for proper instructions to deactivate, disable, or take off line any devices in the impacted area. Work must not proceed until the FM Building Systems Technician confirms the deactivation of the impacted fire alarm devices. Minimal impairment of the fire detection systems must be maintained at all times. Project Manager (PM), Inspectors of Record (IOR), tradesmen, and contractors must ensure fire detection systems are isolated where hot work is being performed, as appropriate.

5.9 Personal Protective Equipment (PPE) ([https://www.ehs.uci.edu/programs/\\_pdf/safety/ppe-program.pdf](https://www.ehs.uci.edu/programs/_pdf/safety/ppe-program.pdf)) – The following PPE must be used to protect the employee from physical hazards while performing hot work

- Goggles and/or safety glasses must be worn to protect the eyes;
- Welding helmets must be worn to protect the face and to protect users from arc rays, welding sparks, and splatters;
- Protective clothing must be worn to cover all body parts and to protect against ultraviolet and infrared flash burns; and
- Flame-resistant gloves must be worn to protect the hands during hot work activities.

## **6. Reporting Requirements**

All UC Irvine employees intending to perform hot work activities must complete an online Hot Work Permit Request Form (see Section 5.1) and submit it to EH&S for review and approval. All D&CS Project Managers and/or Inspector of Record (IOR) supervising general contractors intending to perform hot work activities must also complete a hot work permit and submit it to the DCFM for review and approval.

All current and completed hot work permits must be retained in department records for a minimum of one (1) year.

## **7. References**

- Title 8, California Code of Regulations, Sections 4845-4848, Gas Systems for Welding and Cutting, and Fire Prevention and Suppression Procedures.
- Title 8, California Code of Regulations, Sections 4850-4853 Electric Welding, Arc Welding and Cutting, Resistance Welding, and Inert-Gas Metal-Arc Welding.
- Title 8, California Code of Regulations, Section 3221, Fire Prevention Plan.
- Title 8, California Code of Regulations, Section 3302, Injury and Illness Prevention Plan.
- California Fire Code, Article 49, Section 4901.3, Hot Work Permits.