

# UC BERKELEY WELDING & HOT WORK PROGRAM

## WELDING & Hot Work Program Manager:

Gary Bayne, CSP, Health & Safety Specialist  
Phone: (510) 643-9476  
E-mail: g\_bayne@berkeley.edu  
Team: Health & Safety  
Associate Director: Brandon DeFrancisci



The Welding & Hot Work program is comprised of two main subject areas—designated hot work areas and temporary hot work permits. It provides procedures and supplemental information for welding and hot work in any situation. It also provides specific guidance in the key program elements of: roles & responsibilities, hot work permits, PPE, training requirements, and recordkeeping.



## Overview

Buildings may contain both combustible<sup>1</sup> and flammable<sup>2</sup> materials. Any open flame, spark, or other ignition source presents a fire hazard to buildings, structures and materials, and most importantly, a significant injury potential.

This program is designed to prevent injuries, prevent fire, control hazards, and to ensure compliance with Cal/OSHA safety regulations and the California Fire Code. The procedures outlined in this program must be followed by staff who perform welding and other hot work on UC Berkeley property. Throughout this document the phrase “hot work” will be used to represent the concept of “welding and other hot work” as used in the California Fire Code, and as defined on page 6 of this document.

Additionally, this program details procedures (and practical guidance) for performing hot work safely. These include the program roles of the **operator** performing hot work, the **fire watch**, and the **permit authorizing individual (PAI)**. Shop management and the

---

<sup>1</sup> A combustible material is any material capable of burning, generally in air under normal conditions of ambient temperature and pressure. In the case of liquids, has a flash point above 199.4°F (93°C). [Reference GHS Cal/OSHA definitions.] The California Fire Code defines a combustible liquid as having a flash point at or above 100°F (38°C).

<sup>2</sup> A material that can readily undergo combustion in the presence of a source of ignition under standard circumstances. In the case of liquids, has a flash point at or below 199.4°F (93°C) [Reference GHS class 1-4]. The California Fire Code defines a flammable liquid as having a flash point below 100°F (38°C).

## UC BERKELEY WELDING & HOT WORK PROGRAM

establishment of designated hot work areas are other key elements. The program also contains supplemental information that is useful to educators, industrial hygienists, engineers, and similar parties responsible for safety and health.

Hot work procedures are a key component of this program and apply to all hot work operations regardless of whether the hot work is done in designated hot work areas or at temporary locations in the field.

The permit process is designed to prevent fire, prevent injury, and improve overall safety and is required for hot work areas outside officially designated hot work areas. Official designated hot work areas are inspected and approved by the Campus Fire Marshal, and do not require a hot work permit.

## Contents

### Introduction

[Purpose](#)

[Scope and Applicability](#)

[Definitions](#)

[Roles and Responsibilities](#)

[Principle Investigators](#)

[Research Assistants](#)

[Facilities Maintenance and Research “Supervisors”](#)

### Designated Hot Work Areas

[Design of Designated Hot Work Areas](#)

[Requirements of a Designated Hot Work Area](#)

[Designated Hot Work Area - Maintenance Procedures](#)

[Cylinder Storage](#)

[Protection of Personnel and Hot Work Areas](#)

[Ventilation](#)

[Hot Work Equipment Selection](#)

### Hot Work Permits

[Hot Work Permit Procedure](#)

[Reducing or Increasing the Fire-Safe Distance](#)

[Fire Watch](#)

[Operators](#)

[Permit Authorizing Individual \(PAI\)](#)

[Personal Protective Equipment \(PPE\)](#)

[Protective Clothing – Selection and Preparation](#)

## Hot Work Permits (Cont'd)

[Eye, Face and Head Protection – Selection and Preparation](#)

[Hearing Protection](#)

[Gloves](#)

[Respiratory Protection](#)

[Training Requirements](#)

[PI or Supervisor](#)

[Permit Authorizing Individual, Fire Watch, and Operators](#)

[Operators \(in addition\)](#)

## Miscellaneous

[Recordkeeping Requirements](#)

[References:](#)

[Issued By](#)

[Attachments](#)

[HOT WORK PROGRAM - FAQ](#)

# UC BERKELEY WELDING & HOT WORK PROGRAM

## Purpose

The purpose of this program is to protect persons from injury and illness, and to protect property and equipment from damage by fire and explosions resulting from flame, spark, or other ignition source; especially welding which is the most common type of hot work.

By adhering to this program, all hot work operations conducted on UC Berkeley property comply with Cal/OSHA regulations and the California Fire Code.

Implementation of procedures and adherence to the requirements outlined in this program are mandatory for all persons performing hot work on UC Berkeley property, including: operations in research, instruction, housing, food preparation, and property maintenance. Hot work program training is provided to all affected UC Berkeley personnel. However, UC Berkeley does not provide this training to contractors.

## Scope and Applicability

Adherence to procedures outlined in this program is mandatory for persons in any UC Berkeley department performing operations (indoor and outdoor) that produce heat adequate to ignite materials. This may include, but is not limited to:

- Oxy-fuel gas welding, cutting, heating (See attachment 3 for safety guidance on blended gas torch systems)
- Arc welding and cutting
- Resistance welding
- Plasma cutting
- Brazing
- pipe sweating/flame soldering
- Heat treating
- Grinding
- Any work requiring use of a torch

Exceptions:

- Laser cutting and all other laser use (Laser use must be approved by the campus Laser Safety Officer (EH&S) and the Non-Ionizing Radiation Safety Committee).
- Candles used in research and theater arts, if attended for the duration of use.
- Ovens specifically designed and built by a reputable manufacturer with a Nationally Recognized Testing Laboratory (NRTL) certification (such as Underwriters Lab (UL)) for heat treatment or annealing of research materials.
- Electric soldering irons

## UC BERKELEY WELDING & HOT WORK PROGRAM

- Bunsen Burners and other flame operations in Labs or spaces design and supplied for this type of equipment
- Stoves and other cooking operations
- Candles
- Pyrotechnics or special effects

### Definitions

**Allied Processes** – A code term used to describe hot work processes such as arc cutting, oxygen cutting, thermal spraying, and plasma cutting.

**Combustible** – Generally refers to any material capable of burning, generally in air under normal conditions of ambient temperature and pressure. The GHS Cal/OSHA defines a combustible liquid as having a flash point above 199.4°F (93°C). The California Fire Code defines a combustible liquid as having a flash point at or above 100°F (38°C).

**Designated Hot Work Area** – A permanent location designed for safe hot work operations and approved by the UC Berkeley Fire Prevention Division.

**Flammable** – Generally refers to materials that can readily undergo combustion in the presence of a source of ignition under standard circumstances. The GHS Cal/OSHA defines a combustible liquid as having a flash point at or below 199.4°F (93°C). The California Fire Code defines a flammable liquid as having a flash point below 100°F (38°C).

**Hot Work** – Any operation which requires use of an open flame, or which produces sparks or heat sufficient to ignite nearby materials; hot work operations include cutting, welding, brazing, soldering, thermite welding, induction welding, grinding, thermal spraying, pipe thawing, installation of torch-applied roofing, or any other activity that uses open flame or generates temperatures sufficient to ignite materials.

**Hot Work Area** – The area exposed to sparks, hot slag, radiant heat, or convective heat as a result of the hot work. (CFC § 202)

**Hot Work Equipment** – Electric or gas welding or cutting equipment used for hot work. (CFC)

**Hot Work Permit** – A document issued for the purpose of verifying the safety of an area where hot work is to be conducted, as per the requirements of this program. Permits are issued by the Permit Authorizing Individual under this hot work program permitting Hot Work to be done. Hot Work permits are issued for any Hot Work being done outside of Designated Areas.

**Non-ionizing Radiation** – Lasers, electron beams, or any other type of electromagnetic radiation that does not carry enough energy to ionize atoms or molecules; within the

## UC BERKELEY WELDING & HOT WORK PROGRAM

context of hot work, this is limited to ultraviolet light, lasers, and the infrared light that is generated during research and instruction.

**Permit Authorizing Individual (PAI)** – Performs the initial safety assessment of the hot work area, as well as daily re-assessments before hot work resumes. Ensures compliance with the safe work requirements listed in the [hot work permit](#) section of this program before approving the new permit for each day of hot work. Must either act as fire watch, or verify that a fire watch is on site and has signed the hot work permit. Completes and signs the hot work permit. May act as fire watch simultaneously, but not as operator.

**Principle Investigator (PI)** – Is the holder of an independent grant administered by a university and the lead researcher for the grant project, usually in the sciences, such as a laboratory study or a clinical trial. The phrase is also often used as a synonym for "head of the laboratory" or "research group leader". PI's manage the compliance of their research with this safety program. They may delegate personnel to fill the programmatic roles of fire watch, operator and PAI, or act in some of the programmatic roles themselves. They demonstrate implementation of this program by maintaining hot work permits and training documentation as part of their research records.

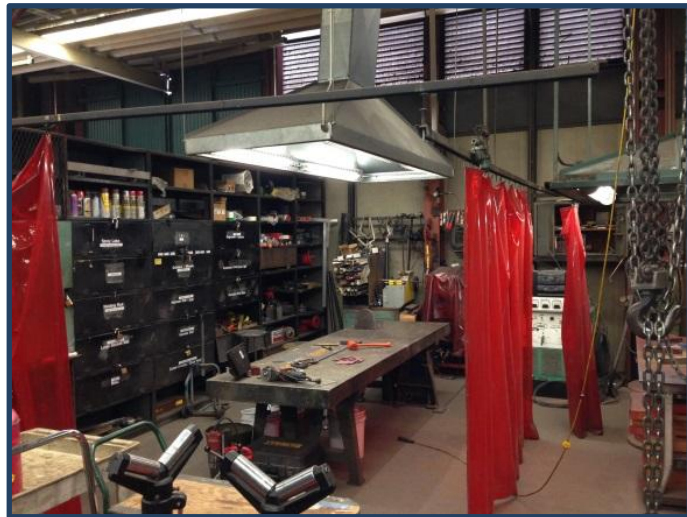
**Qualified Person** – A person who by reason of training, education, and experience, has been determined by their supervisor to be knowledgeable in the operations to be performed and is competent to identify and control the hazards involved.

**Welder** – Any operator of electric or oxy fuel gas welding or cutting equipment, or person performing allied processes. This includes educators and students who are engaged in similar activities.

**Welding Curtain** – A heat-resistant hanging barrier designed to contain hazards that result from hot work such as exposure to sparks or ultraviolet light; they are hung in areas where work such as grinding, heat treating, sandblasting, and light-duty welding is performed.

**Welding Pads** – A heat-resistant fabric mat designed to protect materials underneath it against ignition; pads are placed on the surface of flammable materials

directly under a hot work operation where hot debris might cause damage or start fires.



# UC BERKELEY WELDING & HOT WORK PROGRAM

## Designated Hot Work Areas

### Design

A designated hot work area is an area specifically designed and approved\* for hot work. It is constructed of non-flammable or fire-resistive material, is free of flammable objects, and isolated from adjacent areas not designed for hot work.

### Permit Approval

A designated hot work area must be approved by the campus fire marshal or their designee who has been trained in the California Fire Code, Chapter 35 – 2013 Edition, *Welding and other Hot Work\**, Cal/OSHA §§ 4848, 3219, and 3221. Once established, designated hot work areas must be inspected or reviewed annually (and documented) by a responsible supervisor to ensure ongoing fire safety.

To find out more about establishing a designated hot work area, contact the EH&S fire prevention division at (510) 642-3073.

\* Per the CFC a permit (referred to as “approval” in this document) is required for a designated hot work area. A permit can be issued for a certain period of time and be subject to periodic inspections.

### Requirements of a Designated Hot Work Area

The California Fire Code (CFC) § 3504 - 2013 Edition states that a work area must have the following design characteristics to be classified as a designated hot work area (NOTE: This list is not all inclusive of the requirements of the CFC. See CFC Chapter 35 for additional requirements.):

1. Designated hot work areas must be equipped with portable fire extinguishers.
2. Combustible materials must be removed or must be provided with appropriate shielding to prevent ignition from sparks, slag, or heat.
3. Openings or cracks in walls, floors, ducts, or shafts must be tightly covered to prevent the passage of sparks to adjacent or hidden areas. If they cannot be covered, they must be shielded by fire-resistant guards. Fire-safe curtains must be provided to prevent passage of sparks or slag out of the designated hot work area.
4. Floors are kept clean and free from trip, slip and fall hazards.
5. Floor surfaces must be noncombustible.





## UC BERKELEY WELDING & HOT WORK PROGRAM

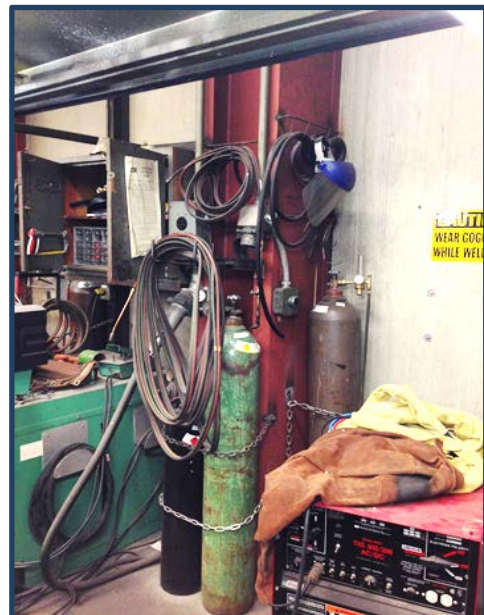
6. Conveyor systems that are capable of carrying sparks to distant combustible materials are shielded or shut down during hot work activities.
7. Partitions-to prevent the passage of sparks, slag, radiant heat, and UV light from the hot work area:
  - a. Shall be noncombustible.
  - b. Securely connected to the floor so that no gap exists between the floor and the partition.
  - c. Openings in partitions must be protected by welding-grade curtains or other permanent physical barriers, either attached to the structure, or of rugged portable construction.
8. Signs are posted labeling the area “Designated Hot Work Area”.
9. Fire protection systems including fire sprinkler systems and fire alarm systems shall remain in service, unless specifically permitted to be isolated by the Campus Fire Marshal. The PAI shall contact the Campus Fire Marshal to discuss special conditions that would allow the isolation of any fire protection system. This may involve additional fire watches for the building.
10. An oxygen-fuel gas system using two or more manifolded cylinders of oxygen shall be in accordance with NFPA 51.
11. Compressed gas cylinders and fuel gas cylinders shall comply with CFC Chapters 35 and 53.

Additional requirements are described in the [Design and Maintenance Procedures](#) section below.

### Design and Maintenance Procedures

#### Cylinder Storage and Use

- Cylinders must be kept far enough away from welding or cutting operations so that sparks, hot slag, or flame will not reach them. Otherwise, fire-resistant shields are provided for protection.
- Cylinders containing oxygen, acetylene or any other fuel or gas must not be taken into confined spaces.
- Welding fuel-gas cylinders are placed with valve end up whenever they are in use or being stored.
- When in use, nothing is placed on top of an acetylene cylinder which may damage the safety device or interfere with the quick closing of the valve.
- Cylinders must be securely stored upright by two non-combustible chains or straps located at the top one-third and bottom one-third of the cylinder height. Chains and straps must be snug. Rope or string is not acceptable.



## UC BERKELEY WELDING & HOT WORK PROGRAM

- Welding-gas cylinders must be separated by a distance of 20 feet, or by a non-combustible partition 60 inches high or taller.

### Protection of Personnel

- Prior to performing hot work on equipment that contains (or has contained) flammable materials, it must be thoroughly cleaned, dried, and purged.
- Maintain good housekeeping at all times. Keep gasses separated, remove all dust, debris, flammable objects and substances from the area, properly store cables and hoses, and limit trip and fall hazards.
- Protect persons in areas adjacent to the hot work by installing flame-resistant screens or shields. Separate adjacent hot work stations with similar partitions.



### Ventilation

Welding and cutting can release potentially hazardous materials from fluxes, coatings, and metals into the atmosphere. Ventilation within the designated hot work area must be sufficient to keep concentrations of airborne contaminants below the Cal/OSHA Permissible Exposure Limits (PEL).

If natural ventilation is not sufficient, mechanical ventilation such as exhaust fans or smoke filters must be provided to eliminate the airborne hazards. If mechanical ventilation is not sufficient to maintain contaminants below the PELs, then operators must be provided with respirators.

There are several types of mechanical ventilation including local exhaust, forced air, and general area mechanical air movement. Local exhaust ventilation is preferred, and should be placed as near as practicable to the hot work. Forced ventilation delivers air to workers at a positive pressure, such as a fan placed so that it moves fresh air across the welder's face.

## UC BERKELEY WELDING & HOT WORK PROGRAM

General mechanical ventilation may be necessary in addition to forced ventilation. Examples include roof fans, wall or window exhaust fans, and similar large area air movers. General mechanical ventilation is not usually satisfactory for health hazard control but is often helpful when used in addition to local exhaust or forced ventilation.

In locations where conditioned air or space-logistics prevent direct exhaust of smoke, a local smoke remover may be used. This is a portable smoke removal system that scrubs hot work smoke and particulates from the air and exhausts the air back into the work area.



### Equipment Selection

All electrical and gas hot work equipment must be approved by a Nationally Recognized Testing Laboratory (NRTL) such as Underwriters Laboratory or similar per the current Federal OSHA NRTL Program list at the following link:

<https://www.osha.gov/dts/otpca/nrtl/>

### Hot Work Permit Procedure

The CFC requires a permit for temporary hot work areas. For temporary hot work locations, a new hot work permit must be completed, signed, and posted for each day hot work is performed. See [Attachment 1](#) for a copy of the UC Berkeley Hot Work Permit. The permit must be issued by a permit authorizing individual (PAI). For jobs that occur in both indoor and outdoor locations, a separate permit for each location must be issued.

The safety principles and procedures described in the previous section on designated hot work areas, specifically: **Cylinder Storage and Use, Protection of Personnel, Equipment Selection, and Ventilation**, apply also to hot work permit areas.

Before a hot work permit is issued, a safety assessment is completed and the following safe work conditions must be verified by a PAI:

1. The hot work equipment must be in safe operating condition and good repair.
2. Fully charged and operable fire extinguishers appropriate for the type of possible fire must be immediately available at the work area.
3. All combustible materials within a 35 foot radius from the hot work must be

## UC BERKELEY WELDING & HOT WORK PROGRAM

- relocated. If relocation is impractical, the materials must be protected by an NRTL-approved welding curtain, welding blanket, welding pad, or equivalent barrier.
- a. To prevent the sparks from passing underneath covers, they must be tight against the floor and held in place from movement. Where covers overlap to cover a pile of combustible material, they must be tightly clipped together.
4. The floor must be swept clean for a radius of 35 feet from the hot work in areas where combustible materials such as paper, wood shavings, textile fibers, or rubber are on the floor.
  5. Combustible floors must be kept wet, covered with damp sand, or protected by an NRTL-approved welding blanket, welding pad, or equivalent barrier.
    - a. Where floors have been wet down, operators must be electrically-isolated from equipment and protected from possible shock.
  6. Openings or cracks in walls, floors, or ducts within 35 feet of the site must be covered or sealed with approved fire-rated or non-combustible material to prevent the passage of sparks to adjacent areas.
  7. Ducts and conveyor systems that might carry sparks to distant combustible materials must be shielded or, preferably, shut down.
  8. If hot work is done near walls, partitions, ceilings, or roofs of combustible construction, they must be protected by an approved welding curtain, welding blanket, welding pad, or equivalent.
  9. If hot work is done on one side of a wall, partition, ceiling, or roof, precautions must be taken to prevent ignition of flammable materials on the other side by relocating the materials. If it is impractical to relocate the materials, a person acting as fire watch must be provided on the side opposite from where the work is being performed.
  10. Hot work must not be attempted on a partition, wall, ceiling, or roof that has a combustible covering or insulation, or on walls or partitions with combustible panel construction.
  11. Hot work that is performed on pipes or other metal that is in contact with combustible walls, partitions, ceilings, roofs, or other materials must not be undertaken if the work is close enough to cause ignition by heat conduction.
  12. Access to the permitted hot work area by people not involved in the work must be controlled.
  13. Curtains, closed doors, barricades or other means must be used to prevent any ultraviolet radiation from leaving the permitted area.
  14. If water hoses are located within the permitted hot work area, they must be connected and ready for service, but it is not required that they be unrolled or charged with water.
  15. A fire watch must be present. (This is required irrespective of the fire alarm system status)

Special precautions must be taken to avoid accidental activation of automatic fire or smoke detection or suppression systems such as sprinklers or other special extinguishing systems. When conducting hot work in close proximity to a fire sprinkler, a wet rag or similar heat barrier must be laid over the sprinkler head during hot work, and removed at the conclusion of the operation.

## UC BERKELEY WELDING & HOT WORK PROGRAM

Disabling of any fire detection or alarm system must be approved by the fire prevention division of EH&S ((510) 642-3073), and noted as such on the hot work permit. The supervisor or designee is responsible for requesting a Fire Protection System Shutdown Request from Facility Services. Unless there is an emergency, the typical Shutdown requires an 11 day notice. Only then may Facilities Services ((510) 642-1032) personnel disable the alarms or detectors. Facilities Services will also re-enable the alarms or detectors when the hot work is concluded. The supervisor is responsible for verifying that any fire alarms disabled during the work were reactivated upon its completion. The supervisor acknowledges this verification by signing the permit.

Regardless of the scope of work and local conditions, the PAI must assess the area and issue a new hot work permit for each day of work.

### Supervisors: Facilities Maintenance, Research, etc.

When hot work is done outside of a designated hot work area with an approved [hot work permit](#), the supervisor is responsible for the following:

- Designate individuals to perform the programmatic roles of “permit authorizing individual (PAI)”, “operator”, and “fire watch”.
- Ensure that individuals performing programmatic roles receive hot work program training.
- Ensure that a hot work permit is issued by a permit authorizing individual (PAI) before the hot work starts each day.
- Ensure that a fire watch signs the day’s hot work permit before the hot work starts, is present when required, and remains on site during the hot work and for at least 30 minutes after the hot work is complete.
- Obtain approval from the UC Berkeley Fire Prevention Division whenever a fire alarm needs to be deactivated for a project (Call the Facilities Services Shut-down Desk at (510) 642-1032 to request a scheduled deactivation). Supervisors are also responsible for ordering that the alarms be reactivated at the end of each shift. If the alarms cannot be reactivated, the supervisor must coordinate a fire watch for the building.
- If applicable, verify that any disabled fire alarms were reactivated. Sign the supervisor section on the Hot Work Permit acknowledging the verification and filing of the permit each day.
- Where fire sprinkler systems are in the hot work area, the supervisor shall ensure the fire sprinkler system is not impaired. Hot work is not permitted where fire sprinkler systems are impaired in accordance with the CA Fire Code.

### Reducing or Increasing the Fire-Safe Distance

The PAI may enlarge or reduce the fire-safe work area as local conditions allow, but must describe these deviations from protocol on the hot work permit. When, for example, windy



## UC BERKELEY WELDING & HOT WORK PROGRAM

conditions enable sources of ignition to travel farther than 35 feet, the permit conditions must be extended to the estimated distances and area indicated by local conditions. When it has been determined that the hot work will not generate or transport ignition sources outside of the immediate area, the permit conditions may be reduced to the area of safe operation.

### Permit Authorizing Individual (PAI)

The permit authorizing individual (PAI) has the following responsibilities:

- Performs the initial safety assessment of the hot work area, as well as daily re-assessments before hot work resumes.
- Ensures compliance with the safe work requirements listed in the [hot work permit](#) section of this program.
- Must either act as fire watch, or verify that a fire watch is on site and has signed the day's hot work permit.
- Completes and signs the hot work permit every day.
- May act as fire watch simultaneously, but not as operator.

### Operators

The operator is the person using the equipment that produces a potential ignition source.

Operators have the following responsibilities:

- Must be qualified to fill the roles of PAI and fire watch, though they must not fill either of these roles while acting as operator.
- Must be qualified to operate the hot work equipment. Qualification is determined by their supervisor.
- Must verify that the equipment is safe to use; that its condition will not cause injury or accidental ignition.
- Is responsible for performing the hot work in accordance with hot work procedures and all precautions listed on the hot work permit.
- Must wear all required personal protective equipment (PPE).
- Must not perform hot work unless all persons within the hot work area are also wearing appropriate PPE.
- Must stop work and inform their supervisor if conditions change after the hot work permit is issued.

When working outside of a designated hot work area, operators have the following additional responsibilities:

- Must not begin hot work until the daily [hot work permit](#) has been completed, signed, and posted on site by the PAI.
- If a fire watch is required, the operator may only begin hot work once the fire watch has signed the hot work permit.
- If a fire watch is required, the operator may only perform hot work while the fire watch is present. If the fire watch leaves the area, the operator must stop work.

# UC BERKELEY WELDING & HOT WORK PROGRAM

## Fire Watch

A “fire watch” is required whenever combustible material is within 35 feet of the heat-producing operation and cannot be isolated from the work by other means such as welding pads or fire cloths. This requirement includes all areas separated by wall openings, floor openings, or metal partitions within a 35-foot radius from the hot work operation. Such openings might expose combustible material in an adjacent area to ignition temperatures through heat conduction or radiation--which may cause the material to ignite. Additional fire watches are required where areas below the hot work area are exposed to the hot work area. A fire watch is not required in a hot work area that has no fire hazards or combustible materials.

The fire watch duties can be assigned to anyone who understands the hazard of the hot work being performed and the limitations placed on the work operation by the person issuing the hot work permit (PAI) for that day. The fire watch reviews and signs the permit prior to the start of work. The fire watch has the responsibility to make certain the hot work area is maintained in a fire-safe condition throughout performance of the hot work and has the authority to stop the hot work if unsafe conditions are observed.

If it is not possible for one fire watch to observe the entire area for potential fire, code requires that additional fire watches be assigned to ensure that the exposed areas are monitored.

Persons acting as fire watch must:

- Receive annual training on the safe operation of fire extinguishers.
- Understand the basic hazards of any combustible construction and materials.
- Maintain proper isolation of all hot work operations from combustible or flammable materials.
- Mitigate fire exposure hazards adjacent to, above or below the hot work operation.
- Keep a fire extinguisher with a minimum rating of 2A:20B-C, or a charged water hose, within 30 feet of the hot work location.
- Know how to trigger the fire alarm and call UCPD.
  - (510) 642-333 – Cell Phone
  - 911 – Campus Landline

When calling UCPD to report a fire, include the building name, floor, area or room number, injuries, and any other important information.

- Watch for fires in all exposed areas.
- Extinguish fires only when it is obviously within the capacity of the available equipment.
- Trigger the fire alarm if immediate attempts to control a fire are not successful.
- Maintain fire watch for the duration of hot work and for at least 30 minutes after completion of the hot work.

## UC BERKELEY WELDING & HOT WORK PROGRAM

The fire watch may also act as the PAI, but never the operator, on the same job.

### Personal Protective Equipment (PPE)

#### Protective Clothing – Selection and Preparation

Hot work clothing provides sufficient coverage and is made of noncombustible and sturdy materials to minimize skin burns caused by sparks, spatter, radiant heat, and ultraviolet light. Appropriate protective clothing for a hot work operation will vary by material and coverage based upon location worn on the body and type of hot work.

Clothing should be kept reasonably clean, as oil and grease can reduce its protective qualities and could be flammable. Frayed clothing is particularly susceptible to ignition and must not be worn when performing hot work. Flame resistant clothing made from tightly woven materials such as wool and heavy cotton or seamless leather is preferable.

Sparks may lodge in rolled-up sleeves, pockets of clothing, or cuffs of overalls or trousers. Sleeves should be rolled down and collars kept buttoned. Pockets should be eliminated or protected by leather aprons or welding jackets worn over clothing. If pockets are worn, they should be emptied of combustible materials. Trousers should overlap shoe tops and ankles to prevent spatter from getting into shoes. Work boots that cover the ankle are preferable to low-rise shoes.

#### Eye, Face and Head Protection – Selection and Preparation

**Welding** - Any persons who might be exposed to ultraviolet light (UV) generated by welding must wear eye protection with filter lenses specifically designated for the type of welding they are doing. Personnel must contain any long hair under PPE. Then, wear a welding helmet with the appropriate shade number as shown in the table below for eye and face protection. (Prescription glasses can be worn under the welding helmet).

Welding operation	Shade No.
Shielded metal arc welding (SMAW, MMA, MMAW, flux shielded, stick):	
- 1/16-, 3/32-, 1/8-, 5/32-inch electrodes	10
- 3/16-, 7/32-, 1/4-inch electrodes	12
Gas-shielded arc welding (GMAW, MIG, MAG), (nonferrous) - 1/16-, 3/32-, 1/8-, 5/32-inch electrodes	11
Gas-shielded arc welding (GMAW, MIG, MAG), (ferrous):	
- 1/16-, 3/32-, 1/8-, 5/32-inch electrodes	12
- 5/16 -, 3/8-inch electrodes	14
Gas Tungsten arch welding (GTAW, TIG)	11
Atomic hydrogen welding	10-14
Carbon arc welding or cutting (gouging)	14
Medium cutting, 1 inch to 6 inches	4 or 5



## UC BERKELEY WELDING & HOT WORK PROGRAM

Heavy cutting, 6 inches and over	5 or 6
Gas welding (thin material) up to 1/8 inch	4 or 5
Gas welding (medium material) 1/8 inch to 1/2 inch	5 or 6
Gas welding (thick material) 1/2 inch and over	6 or 8

**Soldering / Brazing** - Prior to performing non UV-generating hot work such as common soldering and brazing operations, personnel must contain any long hair under PPE. Then, wear a clear full face shield over prescriptive glasses or eye-goggles for eye and face protection. The goggles or prescriptive glasses must have the appropriate lens shade number in the table below based upon the type of soldering / brazing being done.

Soldering	2
Torch brazing	3 or 4
Light cutting, up to 1 inch	3 or 4

### Hearing Protection

Hearing protection must be used where high noise hazards exist. Examples of high-noise hot work include air carbon arc cutting (gouging) and grinding steel prep work in a manhole.

### Gloves

All welding and cutting must be conducted wearing flame resistant and electrically nonconductive gloves that allow adequate dexterity for manipulation of the welding equipment and controls in addition to weld-filler rods. Gloves must be in good repair with no holes or frayed seams and free of oil or water residue. Gloves must cover the cuff of long-sleeve shirts, fit snugly around the forearm and preferably protect up to mid-forearm in length.

### Respiratory Protection

When ventilation of the hot work area is not adequate to maintain healthy breathable air, respiratory protective equipment must be used. Personnel wearing it must be enrolled in the UC Berkeley Respiratory Protection Program. Only respirators approved by EH&S and specific to the hot work hazards may be worn. The UC Berkeley Respiratory Protection Program requires medical clearance by University Health Services Occupational Health Clinic, as well as fit-testing and training by EH&S on respirator care and use. Annual enrollment, medical clearance and fit-testing may be required for every person enrolled in the UC Berkeley Respiratory Protection Program. Costs of enrollment are borne by the department doing the hot work. Contact EH&S at (510) 642-3073 to enroll personnel in the Respiratory Protection Program.

# UC BERKELEY WELDING & HOT WORK PROGRAM

## Training Requirements

### PI or Supervisor

- Contents of the hot work program including:
  - Requirement for delegating responsibility to PAI and hot work personnel
  - Programmatic roles played by personnel
  - Design and construction of a designated hot work area
  - Safe hot work practices and procedures
  - Process for completing a hot work permit
  - Importance of retaining the permit at the conclusion of the work
  - Process for alarm shut-down and re-enabling
  - Recordkeeping requirements

### Permit Authorizing Individual, Fire Watch, and Operators

- Contents of the Hot Work Program including:
  - The programmatic roles played by personnel
  - Design and construction of a designated hot work area
  - Safe hot work practices and procedures
  - Process for preparing an area for hot work and completing a hot work permit
  - Process for closing out a hot work permit
  - Familiarity with the process for ordering a fire sprinkler system or-smoke detector or fire alarm shut-down and re-enabling (NOTE: Specific Campus Fire marshal approval is required)
  - Fire Watch – Fire extinguisher training is required
  - Recordkeeping requirements

### Operators (in addition)

- Training in the safe operation of the specific equipment being used for hot work

## Recordkeeping Requirements

- Hot work permits must be kept on file by the issuing department for two years. They must be made available for review by EH&S or regulatory authorities upon request.
- Training records including rosters and subjects covered must be kept by the department for the duration of attendee's employment plus three years. Copies must be provided to EH&S for additional long-term archiving.
- An inventory of designated hot work areas approved by the Campus Fire Marshal is maintained by the Fire Prevention division of EH&S.
- Respiratory protection program training records must be kept for any employees who use respiratory protection. These records are maintained by the responsible department. (Medical Qualification records are maintained at UHS. A copy of fit test and respirator training records are maintained at EH&S.)

## References:

Title 8, California Code of Regulations (CCR)

- §3219 Maintenance of Fire Protection Equipment, Materials and Assemblies

## UC BERKELEY WELDING & HOT WORK PROGRAM

- §3221 Fire Prevention Plan
- §4845 General Precautions
- §4848 Fire Prevention and Suppression Procedure
- §4850 Electric Welding, Cutting and Heating – General Requirements

All electrical equipment used to perform electric operations and processes are installed and maintained in accordance with the California Electrical Safety Orders, and chapters 11, 12, and 13 of the American National Standards Institute, ANSI/ASC Z49.1-94, *Safety in Welding, Cutting and Allied Processes*.

All electrical and other hot work equipment must be approved by an NRTL such as Underwriters Laboratory or similar per the Federal OSHA NRTL program list at the following link: <https://www.osha.gov/dts/otpca/nrtl/>

American National Standards Institute (ANSI) Z49.1-2012, Safety in Welding, Cutting and Allied Processes

National Fire Protection Association (NFPA) 51B-2009, Standard for Fire Prevention During Welding, Cutting, and Other Hot Work

California Fire Code, Chapter 26, Welding and other Hot Work  
2013 California Fire Code §3504.2.2 Fire Watch Requirements

### Issued By

Issued by: EH&S

Date: April 10, 2018

Approved By: Brandon Defrancisci  
Fire Marshal: Amy Chen    Date: April 10, 2018

### Attachments

Attachment 1 – Hot Work Permit  
Attachment 2 – FAQ  
Attachment 3 – Blended Gas Torch Systems

# Attachment 1

# HOT WORK PERMIT

WORK ORDER #: \_\_\_\_\_

WORK DATE: \_\_\_\_\_

**INDOOR**

*Complete sections A, B, and D*

**BUILDING:** \_\_\_\_\_

**ROOM #:** \_\_\_\_\_

**OUTDOOR**

*Complete sections A, C, and D*

**NEAREST STRUCTURE:** \_\_\_\_\_

**SIDE:**

NORTH

SOUTH

EAST

WEST

**APPROX. DISTANCE TO STRUCTURE:** \_\_\_\_\_

**Description of area covered by permit:**

## A. GROUNDS AND FACILITIES INFORMATION *(applies to all hot work)*

Hot work authorized by this permit will be performed within a confined space. *If checked, see below.*

A 4-gas meter is on site

A Confined Space Entry Permit is posted on site

All equipment to be used has been inspected for safe operation by the operator. \_\_\_\_\_  
operator's initials

Fire alarms are available at the site. *If checked, see below.*

Fire alarms have been disabled because of anticipated smoke.

Hot work will be performed near fire sprinklers or smoke alarms. *If checked, see below.*

Sprinklers and/or alarms have been shielded from heat

Shielding has been removed following completion of hot work \_\_\_\_\_  
initials

Fire extinguishers are available at the site in addition to the fire extinguishers designated for any building.

Employees and contractors not directly associated with the hot work have been advised of any flammable materials or other hazardous conditions in the area.

A Fire Watch is on duty.

### **The following precautions have been taken in the hot work area and surrounding 35 feet of space:**

The area is free of combustibile materials. *If not, see below.*

Comubstibile materials in the area are protected from ignition sources with flame-proof covers, or shielded with suitable guards or curtains.

Tanks, vessels, and other enclosed areas that may contain flammable vapors or gas have been tested with a 4-gas meter (or similar instrument), and levels have been verified at <10% LEL.

Cracks or openings in walls, doorways, windows, or floors are closed or covered, or protected with guards or shields.

# HOT WORK PERMIT

## A. GROUNDS AND FACILITIES INFORMATION *(continued)*

Walls, partitions, ceiling, or combustible roofing are protected by fire-resistant shields or guards to prevent ignition.

If hot work is to be done on a metal wall, partition, ceiling, or roof, combustibles on the other side have been removed.

Ducts and conveyor systems that might carry sparks to distant combustibles are suitably protected or shut down.

*Fill out Section B for Indoor Hot Work, OR Section C For Outdoor Hot Work.*

### B. INDOOR HOT WORK

Combustible floors are kept wet, covered with damp sand, or protected by fire-resistant shields. (Where floors are kept wet, personnel operating arc welding or cutting equipment must be protected from possible shock.)

### C. OUTDOOR HOT WORK

Smoke generated by hot work activities is contained or ventilated away from any nearby building's air intakes.

Combustible vegetation or landscaping components are kept wet, or protected by fire-resistant shields.

## D. PROCEDURAL INFORMATION *(applies to all hot work)*

### Type of Heat Production:

gas weld or cut  
arc weld or cut  
grinding  
flame heat  
solder  
other \_\_\_\_\_  
please specify

### The following PPE (personal protective equipment) will be used:

welding helmet	shaded lenses
Nomex coveralls	welding leathers
air purifying respirator	long sleeve shirts
safety glasses/face shield	other: _____
work gloves	<small>please specify</small>

### Permit Authorizing Individual

I have inspected the area, found all applicable fire prevention controls to be in place, and hereby approve hot work in this area, so long as the above-listed conditions do not change.

\_\_\_\_\_  
print name

\_\_\_\_\_  
signature

### Supervisor

I have verified that, if fire alarms were disabled during this work, they were reactivated upon its completion. This report has been filed in accordance with UC Berkeley's Hot Work Program.

\_\_\_\_\_  
print name

\_\_\_\_\_  
signature

### Fire Watch

\_\_\_\_\_  
print name

\_\_\_\_\_  
signature

### Operator

\_\_\_\_\_  
print name

\_\_\_\_\_  
signature

# Attachment 2

## UC BERKELEY WELDING & HOT WORK PROGRAM

### HOT WORK PROGRAM - FAQ

#### **What is hot work?**

Hot work is any kind of work process that utilizes or generates open flame, sparks, hot slag or other kinds of ignition sources. Common kinds of hot work include welding, soldering, brazing, grinding, and other kinds of metal-forming operations. Others include using open flame to melt, seal or reform materials such as roofing tars and some kinds of industrial glues. In some kinds of research, lasers can be used to perform hot work.

#### **Why is the hot work program needed?**

The contents and procedures outlined in this program must be implemented to comply with legal, fire safety, and industrial safety code requirements. Any and all hot work conducted on UC Berkeley property must follow the requirements outlined in this program to comply with the law and risk management requirements of UC insurance carriers.

#### **Does this program apply to indoor and outdoor hot work?**

Yes. A hot work permit is required if combustible materials are within 35 feet of the heat or ignition source. See the [hot work permit](#) section for further information.

#### **Do I need a hot work permit for barbecues?**

No. You do, however, need an [open flame/cooking permit](#) from the fire marshal. Call the EH&S Fire Prevention Division at (510) 642-3073 for more information about open flame/cooking permits.

#### **How can I get training for acting as a permit authorizing individual (PAI), operator or fire watch during hot work operations?**

EH&S provides the training for these programmatic roles. Contact EH&S at (510) 642-3073 and ask for the hot work program manager to arrange for training.

#### **How can I get trained to use a welder or other type of hot work equipment?**

Providing training on the use of any equipment is the responsibility of the department that employs you or that provides instruction to you as part of your coursework. Training for hot work equipment can be delivered by an outside trainer, or provided by someone within the department who is qualified to train you. EH&S does not provide training on safe use of specific kinds of welders or other types of hot work equipment.

#### **Who do I contact to get an area designated for hot work?**

The UC Berkeley Fire Marshal or a deputy fire marshal will review and approve a designated hot work area. Contact EH&S at (510) 642-3073 and ask to speak to someone in the Fire Prevention division for help with creating and designating an area for hot work.



# Attachment 3

## Safety Guidance for Blended Gas Torch Systems

*Blended gas mixtures for torches, such as fuel and oxygen, are used for a variety of purposes in research labs; from welding fabrication to soldering, brazing to glassblowing and sealing. Proper use of oxy-fuel torch systems is essential to safe practices both with the torch and the system as a whole. Improper mixing of fuel and oxygen can create explosive atmospheres.*

### Definitions:

- **Flashback Arrester:** A flashback arrester is a device used to prevent the backflash of a flame from the torch back through the hose. Most modern flashback arrestors also contain check-valves which act to prevent the backflow of gases.
- **Check-Valve or Backflow Preventer:** A device that prevents the backflow of gases into the line, Cal/OSHA requires backflow prevention where oxygen and gas are used in torches.

### Types of Oxy-Fuel Systems:

- **Stand-alone system** – The most common type of oxy-fuel set-ups involves two separate cylinders, 1 oxygen and 1 fuel source (e.g. methane, propane, acetylene, hydrogen). These systems involve the use of regulators on each cylinder to control the output pressure of each line. Most purchased stand-alone torch set-ups have check valves or flashback arresters installed, but this is not always the case. Without proper safety controls, gas from one cylinder can become mixed within the system with the other gas component, which can lead to a potentially explosive atmosphere. To eliminate that danger, Cal/OSHA requires that all oxy-fuel set-ups have flashback arrestors or at least check-valve devices in place on both lines to prevent the mixing of gases in the lines, regulator, or tanks.
- **House fuel gas systems** – More unique, though prevalent on campus, certain facilities are using piped natural gas (methane) as the fuel for oxy-fuel set-ups. In these instances, it is imperative to make sure the system contains flashback arresters or check valves. House natural gas systems operate at relatively low pressures, and these pressures can fluctuate at times. If the oxygen pressure exceeds that of the natural gas line, and engineering controls such as flashback arresters or check-valves rated for low pressure are not in place, smaller orifice tips (or partially blocked larger orifice tips) on the torch can create enough resistance to gas flow that oxygen can backfeed into the house natural gas system. If this backfeed occurs, the gases will mix and create a risk of explosion.

**Note:** Due to the low pressure on the house side, finding suitable backflow preventers can be difficult as most currently available seem to be rated for higher pressures. A survey of your building's house gas pressure will be necessary prior to implementation of a suitable check-valve. As is the case with the stand-alone system, a flashback arresters or check-valve is required on both lines of the torch system. *The torch should not be used in conjunction with a house natural gas system until the system has been approved as having sufficient engineering controls.*

Additionally, the materials, construction, and properties of the hose tube, along with the reinforcement and cover, shall meet or exceed RMA/CGA specifications (Rubber Manufacturers Association/Compressed Gas Association). See manufacturer's data sheet for confirmation.

**If you are using a torch in conjunction with a house natural gas system, or if you are unsure if your stand-alone system has the necessary safety controls, please contact EH&S for a review of your set-up.**