

# HOT WORK

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## 1.0 Purpose

This program establishes written procedures to prevent fires resulting from temporary operations involving an open flame or that produces heat, sparks, or hot slag. This includes (but is not limited to) brazing, cutting, grinding, soldering, thawing pipes, torch-applied roofing, thermal spraying, adhesive bonding and welding. This program requires the issuance of a Hot Work Permit before beginning work.

## 2.0 Scope

This program applies to University of Waterloo faculty, staff, students and contractors who perform or supervise hot work activities in existing buildings, new construction in existing buildings, and new construction attached to existing buildings.

This program does not apply to areas at UW that are specifically designed and equipped for such operations as shops and teaching facilities for:

- Welding
- Cutting
- Brazing
- Heating
- Soldering

## 3.0 Definitions

**Acceptable limits** — the concentration of chemical and biological agents, including particulate matter (welding fumes) and gases that is acceptable to the regulatory authority.

**Allied processes** — processes that are related to welding, such as brazing.

**Arc-water cutting** — an underwater cutting process used to sever or remove metals by means of elevated temperature from the welding arc and pressurized water to blow the molten metal out of the kerf.

**Autogenous weld** — a fusion weld made without the addition of filler metal.

**Competent** (in relation to a person) adequately qualified, suitably trained, and with sufficient experience to safely perform work without supervision or with only a minimal degree of supervision.

**Constructor** — a person who undertakes a project for an owner; includes an owner who undertakes all or part of a project by himself or herself or by more than one employer.

**Electrode lead** — a secondary circuit conductor transmitting energy from the power source to the electrode holder, gun, or torch.

**Exothermic cutting** — an oxygen-cutting process used to sever or remove metals and other materials by means of the chemical reaction of oxygen with the tubular cutting rod at elevated temperatures. The process may be started by means of the welding arc but is able to burn by itself so that it is not dependent on the arc.

**Fume(s)** — solid particles generated by condensation from the gaseous state, generally after volatilization from melted substances (e.g., welding) and often accompanied by a chemical reaction such as oxidation.

**Hazard assessment** — an assessment of the work area performed by a qualified person to determine the health hazards present and to assist in the selection of preventive measures where required.

**Interlock** — an arrangement whereby the operation of one control or mechanism brings about, or prevents, the operation of another.

**Kerie cable** — a flexible spiral cable with a hollow core enclosed in plastic. Consumable metal strands of the cable have a high carbon content, which burns more slowly than mild steel. It is supplied in 15 and 30 m lengths, three different diameters, and gives 45 min of non-stop cutting at very high speeds.

**Laser** — an acronym for “light amplification by stimulated emission of radiation”.

**Lower flammable limit** — the minimum concentration of a gas or vapor in air required to propagate a flame when a source of ignition is provided.

**Occupational Exposure Limit (OEL)**— the occupational exposure time-weighted average concentration or level of chemical substance, welding fume, or gas particulate that is acceptable to the regulatory authority.

**Owner Designated Representative (ODR)**- refers to the person assigned the duties of project management for the University. The ODR is assigned at, or prior to the project start-up meeting.

**Oxy-arc cutting** — an oxygen cutting process used to sever or remove metals by means of the chemical reaction of oxygen with the base metal at elevated temperatures. The necessary temperature is maintained by an arc between a consumable tubular electrode and the base metal.

**Oxy-gasoline torch** — a cutting process where liquid gasoline is pressurized with air and burned in a specialized torch with oxygen to sever or remove metals by means of the chemical reaction of oxygen with the base metal at elevated temperatures.

**Plume** — the smoke or fume generated by the welding process.

**Qualified person** — someone who, on the basis of education and training, is designated to perform a particular job.

**Robot (industrial)** — automatically controlled, reprogrammable multipurpose manipulator, programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications.

**Safeguard** — a barrier guard, device, or procedure designed for the protection of personnel.

**Welder or welding operator** — any operator of electric or oxygen-fuel gas welding, cutting equipment, or other allied processes.

**Welding cable** — insulated, flexible electrical conductor used as welding leads to carry welding current in an arc welding circuit meeting the safe requirements of the application and use.

**Welding leads** — the work piece lead and the electrode lead of an arc welding circuit.

**Welding personnel** — welders, welding operators, helpers, managers, and supervisors involved with a welding operation.

**Welding process or operation** — any specific type of electric or oxygen-fuel gas welding, cutting, or allied process.

**Work piece lead** — the secondary lead that is attached to the work piece and completes the welding circuit.

## **4.0 Responsibilities**

### **4.1 Safety Office**

- Conduct a periodic evaluation of the program in consultation with Plant Operations Design and Construction and, Central Plant.

### **4.2 Plant Operations Design and Construction**

- Maintain and update the Hot Work Permit.
- ODR (Owner Designated Representative) to ensure that contractors are performing work according to established procedures, standards, legislation.

### **4.3 Plant Operations Central Plant**

- Review Hot Work process and determine if a radio is required, area occupied, whether work occurs on a roof, sprinkler protection, smoke detectors, heat detectors and whether any of the protection services require de-activation.
- Review Hot Work procedures and requirements with the person(s) responsible for the Hot Work.

## 4.4 Contractors

- A valid and signed Hot Work Permit must be obtained 2 business days prior to commencing hot work.
- Review of the current version of the Owner's Hot Work Permit Application shall be completed prior submitting bids and shall be reviewed at the Project Start-Up meeting with ODR prior to commencing the work.
- The signed permit shall be posted at the Work Site.
- Contractor is responsible for the covering and uncovering of smoke detectors to the satisfaction of the ODR and University Maintenance Representatives/Supervisor prior to starting work or upon discovery of such devices as work progresses. Covering smoke detectors with tape, rubber gloves, or any other method that may damage a detector is prohibited.
- Firewatch personnel shall be posted at every operation that is defined as "Hot Work". Upon request by the ODR fire watch personnel shall provide verification of competency in performing Firewatch duties.
- Heaters for welding electrodes shall have manufacturer's label that certifies the purpose of the unit. Job-built heaters are prohibited.
- The remains of welding electrodes shall be picked up and disposed of as soon as each electrode is expended. No welding electrode shall be permitted to fall and remain in the work area.
- All temporary fabrication areas shall be approved by the ODR prior to starting work.

### UWaterloo Firewatch

**Overview:** During construction Fire Alarm and Life Safety Systems shall be kept in operation. If any portion of a Fire Alarm System not limited to zones or devices needs to be deactivated for demolition or construction, then the contractor shall conduct a Firewatch. The Firewatch is to be conducted in accordance with Ontario Fire Code and Authorities having Jurisdiction. Refer to Ontario Fire Code, including but not limited to, Div B Section 8.1.2.2. & 5.11.2.5.

**Operation:** To facilitate the procedures required by the Ontario Fire Code the University of Waterloo has developed the following outline procedure:

1. Contact the University of Waterloo ODR 72 hours prior to initiation of Firewatch. ODR will reserve a radio at Central Plant for the contractor performing the work.
2. Hire a qualified fire alarm contractor to put the device or zone if required on bypass. If the building is addressable then the devices can be bypassed but if a building is conventional then the zone must be bypassed. **Under no circumstance is an entire panel to be bypassed.**

3. If devices are covered during work, then the contractor is to use the manufacturer's recommended cover and remove it at the end of each working day. Once work is completed all devices that were covered are to be re-verified.
4. During Firewatch, personnel conducting watch are to carry the radio, remain onsite for the duration of the fire watch, and tour the entire area affected once every hour.
5. Once the Firewatch has ended;
  - a. Hire a qualified fire alarm contractor to ensure the system and all devices are back online and all troubles are clear.
  - b. Return the radio to Central Plant.
  - c. Notify Central Plant and the ODR the Firewatch is over.

#### 4.5 Faculty/Staff

- Work areas at UW that are NOT specifically designed and equipped for such operations as shops and teaching facilities for hot work, **a valid and signed Hot Work Permit must be obtained by Plant Operations 2 business days prior to the start of hot work.** Fill out a Work Request or call Plant Operations at 519-888-4567 ext. 43793.

### 5.0 Safe Work Procedures

#### 5.1 Welding

The following safety precautions must be followed:

- Personnel involved in welding, cutting, or gouging must be trained in the safe operation of the equipment involved.
- Use appropriate protective measures including ventilation, respirators, helmets, etc.
- Keep the head out of the plume (i.e., smoke or fume generated by the welding process).
- Position the work so that the existing ventilation (i.e., cross drafts from fans, open doors) directs the plume away from the breathing zone.
- Remove any surface coating of the metal prior to welding since they can be volatilized during welding and become constituents of the fume.
- Report any equipment malfunction, defect, or safety hazard to the supervisor.

#### 5.2 Ventilation

Nearly all metals generate fume and a few of the risks are listed below.

- Lung cancer is related to exposure to certain metals, especially nickel and chromium which are found in different grades of steel.

- Metal fume fever from nearly all metals during cutting and welding, can cause vomiting, chills and headache. Effects may be delayed several hours and last 24 hours. Zinc fume from galvanized iron is most severe, though copper and tin fume are nearly as bad.
- Fume poisoning - from such metals as lead, zinc and cadmium, can enter through the nose and mouth through smoking or eating with contaminated hands. Continuous exposure may lead to long term blood disorders, nerve damage and kidney disease.
- Gases and fume fluoride emitted from coating on low hydrogen rods can damage the lungs and cause general poisoning.
- Ozone, a highly toxic gas, produced from any arc-type welding, can cause long term respiratory problems. Ozone has a characteristic irritating pungent odour and can cause short term headaches and nausea.
- Heated coatings and paints can release toxic substances such as cyanide, formaldehyde and isocyanates.
- Fluxes may give off hazardous substances when heated. A Material Safety Data Sheet should be obtained from suppliers to determine hazards of each flux.

To reduce exposure to the various inhalation hazards associated with welding and cutting, adequate local and general ventilation is essential.

### **General ventilation**

- Welding areas should have good general ventilation (about 10 to 12 air changes per minute) that is not re-circulated back into the building.
- Weld out of the plume. Use a tight-fitting welding helmet to shield you from the plume.
- A well-designed welding helmet can help reduce a welder's exposure to welding fumes by diverting the plume away from the welder's breathing zone.

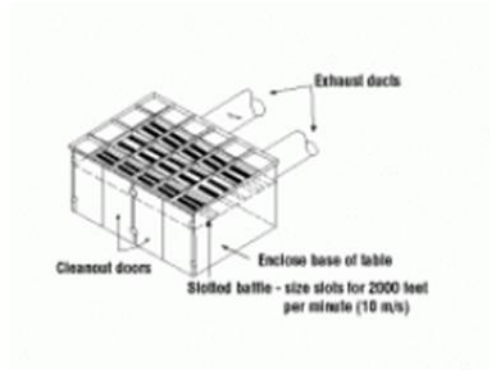


### **Local exhaust ventilation**

- Local ventilation should be used in conjunction with adequate general ventilation to reduce the amount of welding contaminants entering the area.

## Downdraft bench

- A downdraft bench has an open grid work surface. Air is drawn downward through the grid, drawing contaminants into exhaust ducting. Air speed must be great enough to keep contaminants from rising into your breathing zone. If work pieces are too large, they may block the ventilation airflow or cause pockets of high velocity air (which could affect shielding gases).



## Moveable hood

- Flexible ducting allows the capture hood to be moved where required. Provide an air velocity of at least 100 ft/min (0.5 m/s) across the welding arc. Place the hood as close as practical to the work. The optimal location for the hood is about 1 duct diameter from the arc.

## 5.3 Welding and Cutting Areas

All combustible material must be kept more than 15 Meters from the welding or cutting process.

The following fire extinguishers must be available:

- Two 10 lb water fire extinguishers (type 2A)
- One 5 lb dry powder (type ABC)

## 5.4 Welding Equipment

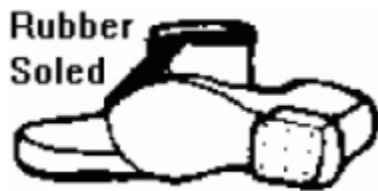
- Equipment must meet the requirements of the CSA Standards C22.2 No.60 or be acceptable to the regulatory authority.
- Evidence of equipment approval must be visible near the name plate of the equipment.

- Open circuit voltages of arc welding and cutting machines must be specified as in CSA Standard C22.2 No. 60.
- Remote portable control devices carried by operator must be connected to an AC circuit lower than 120 V.
- Welding machines must not be used above the current rating that corresponds to the rated duty cycles as specified by the manufacturer.
- Installation of equipment must be installed according with CSA Standards C22.1, or as specified by the regulatory authorities and the manufacturer's instructions.
- Installation, maintenance, and repair of equipment must only be done by a qualified person.

The requirements of section 5.2 of the W117.2-94 Safety in Welding, Cutting, and Allied Processes Standards must be well understood by the operators. The following is a brief summary of them.



- Never allow skin or wet clothing to touch any live metal parts. Always ensure that gloves are dry.
- Never stand on metal or operate in a damp area without protective insulation. Wear gloves and rubber soled shoes and stand on a dry board or platform.



- Replace damaged cables. Never overload them.
- Turn off equipment when not operating.
- Never coil or loop cable around parts of the body.
- Connect the proper size work lead cable to the work piece as close to the work area as possible.
- Keep clothing, work-area, cables, electrode holder, and power supply dry.
- Never use water-cooled electrode holder, and guns if any water leak exists.

- Welding machines must always have the output electrically de-energized when electrodes are removed from gas tungsten arc and plasma welding or plasma cutting electrode holders.
- Take precautions to prevent shock-induced falls.
- Wearers of pacemakers or other electronic equipment vital to life must check with the life support manufacturer and their physicians to determine whether or not a hazard exists.
- Never carry matches or lighters near welding area.

## 5.5 Personal Protection

Wear eye and face protection in welding workplace to protect against radiation and weld spatter. Appropriate eye and face protection shall be selected in accordance with CSA Standard Z94.3.

- Goggles or safety glasses with side shields shall always be worn by all welding personnel in the workplace, even when other eye and face protection is also worn.
- Do not wear contact lenses because foreign bodies in the eye may cause irritation.
- Wear woolen clothing as opposed to cotton which is easily ignited. All clothing should be free from oil or grease.
- Where ventilation alone does not protect the welder, appropriate respiratory protection must be worn as it is required by CSA Standard Z94.4.

## Eye Protection

Shades for shielded metal arch welding (SMAW) CSA W117.2.94

| <b>Electrode size</b> | <b>Arc current in ampere</b> | <b>Shade number</b> |
|-----------------------|------------------------------|---------------------|
| 3/23                  | Less than 60                 | 7                   |
| 3-5/32                | 60-160                       | 10                  |
| 5-8/32                | 160-250                      | 12                  |
| 8/32                  | 250-550                      | 14                  |

Shades for oxygen cutting

| <b>Type of cutting</b> | <b>Material thickness in inches</b> | <b>Shade number</b> |
|------------------------|-------------------------------------|---------------------|
| Light                  | Under 1                             | 4                   |
| Medium                 | 1-6                                 | 5                   |
| Heavy                  | Over 6                              | 6                   |

## 5.6 Torches

- Torch must be pointed away from persons or combustible material.
- Use a friction lighter, stationary pilot flame, or other suitable source of ignition for lighting it.

## 5.7 Welding Safety Measures on Degreasing Solvents

- Metal parts which have been degreased must be completely free of solvents.
- Degreasing and welding operations must be located in different rooms.
- Store chlorinated hydrocarbon solvents far from welding areas.
- Do not use chlorinated hydrocarbon solvents (e.g., perchloroethylene, trichloroethylene) for degreasing at welding stations.
- Other industrial operations (e.g., acid pickling, plating, painting) must be done in areas away of the welding operation area.

## 5.8 Compressed Gas Cylinders

- Gas content must be identified with either its chemical name or its trade name.
- Only the gas supplier or authorized person must fill a cylinder.
- Only the gas supplier must mix gases in a cylinder or transfer gases from one cylinder to another.
- Compressed gas cylinders must be equipped with connections complying with the Compressed Gas Association Standard V-1.
- Cylinders with water weight capacity over 13 kg (30 lb) must be equipped with a means of connecting a valve protection cap or with a collar or recess to protect the valve.
- Temperature of the cylinder contents must *not* be allowed to exceed 55°C (note: hot gases expand and may increase pressure above allowable limits).
- Cylinders showing damage, corrosion, or fire exposure must not be used.
- Cylinders must only be used with a pressure-regulating device.

See the [Compressed Gas Standard](#) for more information.

## 5.9 Laser Beam Welding and Cutting Processes

- Personal operating or maintaining laser beam welding and cutting equipment must have been properly instructed by a manufacturer's representative or by a qualified instructor.
- A laser safety officer (LSO) must be appointed at each facility using lasers for welding or cutting heat sources. The LSO is responsible for ensuring that all operators are properly trained and fully aware of the safe operation and hazards in respect to operation of a laser welding or cutting system.

- Appropriate eye protection must be worn to protect against reflections of laser radiation.
- **Caution:** Laser welding and cutting process produce visible and /or invisible radiation. Reflections of the laser beam itself pose an additional potential hazard. The two areas of greatest concern are eye damage and skin damage.

## 5.10 Plasma Arc Welding, Cutting and Gouging Safety

- Personal assigned to operate or maintain plasma arc welding and cutting, and gouging equipment **must** have been properly trained by a manufacturer's representative or by a qualified instructor.
- Do not operate equipment where gas leaks are suspected.
- Be aware that plasma arc cutting and gouging equipment presents a greater hazard than typical welding equipment because of the higher voltages and high frequency ignites.



- Make certain that primary power supply or power to the control circuitry is disconnected before replacing torch parts.
- Hearing protection must be worn where the noise level exceeds limits as specified by the regulatory authority.
- Eye and skin protection must be worn when exposure to radiation is unavoidable.



- Radiation exposure may also be reduced by mechanical barriers such as walls or welding curtains.

## 6.0 Legislation/Standard

- CAN/CSA-W117.2 Safety in Welding, Cutting and Allied Processes
- O.Reg. 851, Industrial Establishments, Section 78
- Ontario Fire Code

## 7.0 Appendices

- [IHSA Construction Health and Safety Manual- Welding and Cutting](#)
- [CCOHS- Hot Work Record of Revisions](#)

| Date       | Author/Editor  | Change          | Version               |
|------------|----------------|-----------------|-----------------------|
| June 2026  | Robert Mullins | No changes      | Program v.1.0 JUN2026 |
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