

# 21. Welding and Cutting Procedures

## 1.0 Gas Welding and Cutting

### 1.1 Handling Compressed Gas Cylinders

Follow these procedures when handling gas cylinders:

Valve protection caps must be in place and secured.

- Cylinders will be moved by tilting and rolling them on their bottom edges. They must not be intentionally dropped, struck, or permitted to strike each other violently.
- Cylinders must be either firmly secured on a special carrier intended for this purpose or regulators must be removed and valve protection caps put in place before cylinders are moved.
- A suitable cylinder truck, chain, or other steadying device must be used to keep cylinders from being knocked over while in use.
- Oxygen cylinders must be stored separated from fuel gas cylinders or combustible materials by a minimum distance of 20 feet or by a five-foot high non-combustible barrier with a fire-resistive rating of one-half hour. Cylinders must not be stored near elevators, stairs or gangways. Assigned storage must prevent cylinders from being knocked over or damaged.

### 1.2 Placing Cylinders

Cylinders must be kept far enough away from the actual welding or cutting operation so that sparks, hot slag, or flame will not reach them. When this is impractical, fire resistant shields must be used.

Cylinders must be placed where they cannot become part of an electrical circuit. Electrodes must not be struck against a cylinder to strike an arc.

Fuel gas cylinders must be placed with valve end up whenever they are in use. They must not be placed in a location where they would be subject to open flame, hot metal, or other sources of artificial heat.

### 1.3 Use Of Fuel Gas

Employees should understand and follow these safety procedures developed by the State of Washington and specified in WAC 296-24-682:

Before a regulator to a cylinder valve is connected, the valve must be opened slightly and closed immediately. (This action is generally termed "cracking" and is intended to clear the valve of dust or dirt that might otherwise enter the regulator.) The person cracking the valve must stand to one side of the outlet not in front of it. The valve of a fuel gas cylinder must not be cracked where the gas would reach welding work, sparks, flame, or other possible sources of ignition.

The cylinder valve must always be opened slowly to prevent damage to the regulator. For quick closing, valves on fuel gas cylinders must not be opened more than 1 ½ turns. When a special wrench is required, it must be left in position on the stem of the valve while the cylinder is in use so that the fuel gas flow can be shut off quickly in case of an emergency. Nothing must be placed on top of a fuel gas cylinder, when in use, which may damage the safety device or interfere with the quick closing of the valve.

Fuel gas must not be used without reducing the pressure through a regulator attached to the cylinder valve.

Before a regulator is removed from a cylinder valve, the cylinder valve must always be closed and the gas released from the regulator.

If, when the valve on a fuel gas cylinder is opened, there is found to be a leak around the valve stem, the valve must be closed and the gland nut tightened. If this action does not stop the leak, the use of the cylinder must be discontinued, and it must be properly tagged and removed from the work area.

In the event that fuel gas is leaking from the cylinder valve, rather than from the valve stem, and the gas cannot be shut off, the cylinder must be properly tagged and removed from the work area. If a regulator attached to a cylinder valve will effectively stop a leak through the valve seat, the cylinder need not be removed from the work area.

If a leak develops at a fuse plug or other safety device, the cylinder must be removed from the hot work area.

Cylinders not having fixed hand wheels must have keys, handles, or non-adjustable wrenches on valve stems while in service.

Torches must be inspected before use for leaking shutoff valves, hose couplings, and tip connections. Defective torches may not be used.

Torches must be lit by friction lighters or other approved devices, and not by matches or from hot work.

#### **1.4 Regulators and Gauges**

Oxygen and fuel gas pressure regulators, including their related gauges, must be in proper working order while in use.

#### **1.5 Oil and Grease Hazards**

Oxygen cylinders and fittings must be kept away from oil or grease. Cylinders, cylinder caps and valves, couplings, regulators, hose, and apparatus must be kept free from oil or greasy substances and must not be handled with oily hands or gloves. Oxygen must never be directed at oily surfaces, greasy clothes, or within a fuel oil or other storage tank or vessel.

#### **1.6 Hoses**

Fuel gas hose and oxygen hose must be easily distinguishable from each other. The contrast may be made by different colors or by surface characteristics readily distinguishable by the sense of touch. Oxygen and fuel gas hoses must not be interchangeable. A single hose having more than one gas passage must not be used.

When parallel sections of oxygen and fuel gas hose are taped together, not more than 4 inches out of 12 inches may be covered by tape.

All hoses carrying acetylene, oxygen, natural or manufactured fuel gas, or any gas or substance that may ignite or enter into combustion, or be in any way harmful to employees, must be inspected at the beginning of each working shift. Defective hoses must be removed from service.

Hoses which have been subject to flashback, or which show evidence of severe wear or damage, must be tested to twice the normal pressure to which it is subject, but in no case less than 300 p.s.i. Defective hose, or hose in doubtful condition, must not be used.

Hose couplings must be of the type that cannot be unlocked or disconnected by means of a straight pull without rotary motion.

Boxes used for the storage of gas hoses must be ventilated.

Hoses, cables, and other equipment must be kept clear of passageways, ladders and stairs.

### **1.7 Torches**

The operator must clean clogged torch tip openings with suitable cleaning wires, drills, or other devices designed for such purpose.

Torches must be inspected by the operator at the beginning of each working shift for leaking shutoff valves, hose couplings, and tip connections. Do not use defective torches.

Light torches with friction lighters or other approved devices, and not by matches or from hot work.

## **2.0 Arc Welding and Cutting**

### **2.1 Manual Electrode Holders**

Only manual electrode holders which are specifically designed for arc welding and cutting, and are of a capacity capable of safely handling the maximum rated current required by the electrodes, may be used.

Any current-carrying parts passing through the portion of the holder that the operator grips in his hand, and the outer surfaces of the jaws of the holder, must be fully insulated against the maximum voltage encountered to ground.

### **2.2 Welding Cables and Connectors**

Cables in need of repair may not be used. When a cable, other than the cable lead becomes worn to the extent of exposing bare conductors, the portion thus exposed must be protected by means of rubber and friction tape or other equivalent insulation.

### **2.3 Operating instructions.**

Employees must follow these safe means of arc welding and cutting:

- When electrode holders are to be left unattended, the electrodes must be removed and the holders placed or protected so that they cannot make electrical contact with employees or conducting objects.
- Hot electrode holders may not be dipped in water; to do so may expose the arc welder or cutter to electric shock.
- The power supply switch to the equipment must be turned off whenever the welder has to leave his work or stop for any appreciable length of time, or whenever the arc welding or cutting equipment needs to be moved.
- Any faulty or defective equipment must be reported to the shop maintenance manager, instructor, or equipment technician.

### **2.4 Shielding**

Whenever practical, all arc welding and cutting operations must be shielded by non combustible or flameproof screens, which will protect employees and other persons working in the vicinity from the direct rays of the arc.

### **3.0 Protective Clothing**

#### **3.1 General Requirements.**

Employees exposed to the hazards created by welding, cutting, or brazing operations will use proper personal protective equipment. Appropriate protective clothing required for any welding operation will vary with the size, nature and location of the work to be performed. The university will provide equipment for employees.

The following protective clothing may be employed based on the job hazard assessment:

- Except when engaged in light work, all welders should wear flameproof gauntlet gloves.
- Flameproof aprons made of leather, or other suitable material may also be desirable as protection against radiated heat and sparks.
- Woolen clothing is preferable to cotton because it is not so readily ignited and helps protect the welder from changes in temperature. Cotton clothing, if used, should be chemically treated to reduce its combustibility. All outer clothing such as jumpers or overalls must be reasonably free from oil or grease.
- Sparks may lodge in rolled-up sleeves or pockets of clothing, or cuffs of overalls or trousers. It is therefore recommended that sleeves and collars be kept buttoned and pockets be eliminated from the front of overalls and aprons. Trousers or overalls should not be turned up on the outside. *Note: For heavy work, fire-resistant leggings, high boots, or other equivalent clothing should be used.*
- Jackets or shoulder covers made of leather or other suitable materials must be worn during overhead welding or cutting operations. Leather skull caps should be worn under helmets to prevent head burns.

#### **3.2 Eye and Face Protective Wear**

Eye protection sufficient to protect the worker from harmful radiation must be used. Employees in the area not protected from the arc by screening must be protected by filter lenses meeting the standard requirements. When two or more welders are exposed to each other's arc, filter lens goggles must be worn under welding helmets. Hand shields to protect the welder against flashes and radiant energy should be used when either the helmet is lifted or the shield is removed.

Employees whose vision requires the use of corrective lenses must be protected by goggles or eyeglasses of one of the following types:

- Eyeglasses whose protective lenses provide optical correction;
- Goggles that can be worn over corrective lenses without disturbing the adjustment of the glasses.
- Goggles that incorporate corrective lenses mounted behind the protective lenses.

Face and eye protection equipment must be kept clean and in good repair. The use of this type equipment with structural or optical defects is prohibited.

The table in the appendix at the end of this chapter should be used as a guide in the selection of face and eye protection for the hazards and operations noted.

## 4.0 Fire Prevention

When practical, objects to be welded, cut, or heated must be moved to a designated safe location or, if the objects to be welded, cut, or heated cannot be readily moved, all movable fire hazards in the vicinity must be taken to a safe place, or otherwise protected.

If the object to be welded, cut, or heated cannot be moved and if all the fire hazards cannot be removed, combustibles must be shielded using flameproof covers, shielded with metal, guards, curtains, or wet down to help prevent ignition of material.

No welding, cutting, or heating is permitted where the application of flammable paints, or the presence of other flammable compounds, or heavy dust concentrations creates a hazard.

Fire extinguishing equipment must be immediately available in the work area and must be maintained in a state of readiness for instant use.

When the welding, cutting, or heating operation is such that normal fire prevention precautions are not sufficient, additional personnel must be assigned to guard against fire while the actual welding, cutting, or heating operation is being performed, and for a sufficient period of time after completion of the work to ensure that no possibility of fire exists. Such personnel will be instructed by the supervisor or delegate as to the specific anticipated fire hazards and how the fire fighting equipment provided is to be used.

When welding, cutting, or heating is performed on equipment bodies, cowlings or casings, since direct penetration of sparks or heat transfer may introduce a fire hazard to an adjacent area, the same precautions must be taken on the opposite side as are taken on the side on which the welding is being performed.

All drums, pails, and other containers, which contain or have contained flammable liquids, must be kept closed (except when removing or transferring the contents). Empty containers are to be removed to a safe area apart from hot work operations or open flames.

Before welding, cutting, or heating is begun, all drums, containers, or hollow structures that have contained toxic or flammable substances must either be filled with water or thoroughly cleaned of such substances and ventilated and tested. When welding, cutting and heating on steel pipelines containing natural gas, the pertinent portions of regulations issued by the Department of Transportation, Office of Pipeline Safety, Minimum Federal Safety Standards for Gas Pipelines, must be followed.

Before heat is applied, a vent opening must be provided for the release of any built-up pressure caused by the applying of heat to any drum, container, or hollow structure.

## 5.0 Designated Welding Areas

There are two designated welding areas on campus:

- The welding studio in Ingram
- The welding area in the Facilities Management mechanic's shop.

These areas shall meet the following criteria:

- Floors swept and clean of combustibles within 35 feet of work area.
- Flammable and combustible liquids and material will be kept 35 feet from work area.
- Provide adequate ventilation

- At least one 10-lb. dry chemical fire extinguisher should be within 35 feet of the work area.
- Protective dividers such as welding curtains or non-combustible walls will be provided to contain sparks and slag to the combustible free area.

## 6.0 Hot Work Permits

A hotwork permit will be issued for all welding/cutting performed outside of designated welding areas. The Maintenance Supervisor or Environmental Health & Safety Manager is responsible for evaluating and issuing hot work permits for all campus operations. See the permit in Appendix B for criteria that must be met before welding takes place outside of designated areas.

## 7.0 Ventilation And Protection In Welding, Cutting, And Heating

General welding, cutting, and heating not involving toxic conditions or materials described in the following sections, may normally be done without mechanical ventilation or respiratory protective equipment. Mechanical ventilation or respiratory protective equipment must be used when physical or atmospheric conditions create an unsafe accumulation of contaminants.

### 7.1 Mechanical Ventilation

For purposes of this section, mechanical ventilation must meet the following requirements:

- Mechanical ventilation consists of either general mechanical ventilation systems or local exhaust systems.
- General mechanical ventilation must be of sufficient capacity and so arranged as to produce the number of air changes necessary to maintain welding fumes and smoke within safe limits.
- Local exhaust ventilation must consist of freely movable hoods intended to be placed by the welder or burner as close as to the work. The hood must be of sufficient capacity and so arranged as to remove fumes and smoke at the source and keep the concentration of them in the breathing zone within safe limits. If you are uncertain whether your hood meets these criteria, please contact the Environmental Health & Safety Manager for assistance.
- Contaminated air exhausted from a working space must be discharged into the open air or otherwise clear of the source of intake air.
- Oxygen must never be used for ventilation purposes, comfort cooling, blowing dust from clothing, or for cleaning the work area.

### 7.2 Welding, Cutting, Or Heating Toxic Metals

Welding, cutting, or heating in any enclosed spaces involving the metals specified below must be performed with either general mechanical or local exhaust ventilation:

- Zinc-bearing base or filler metals or metals coated with zinc-bearing materials.
- Lead base metals.
- Cadmium-bearing filler materials.
- Chromium-bearing metals or metals coated with chromium-bearing materials.
- Metals containing lead, other than as an impurity, or metals coated with lead-bearing materials.
- Cadmium-bearing or cadmium-coated base metals.
- Metals coated with mercury-bearing metals.

- Beryllium-containing base or filler metals. Because of its high toxicity, work involving beryllium must be done with both local exhaust ventilation and air line respirators.

Wearing approved filter-type respirators will protect employees performing such operations without adequate ventilation. Approved air line respirators will protect employees performing such operations on beryllium-containing base or filler metals. Employees who use respirators must follow the policies and procedures in the Respiratory Protection Section.

### **7.3 Other Employees**

Other employees exposed to the same atmosphere as the welders or burners must be protected in the same manner as the welder or burner.

## **8.0 Welding Or Cutting Containers**

### **8.1 Used Containers**

No welding, cutting, or other hot work may be performed on used drums, barrels, tanks or other containers until they have been cleaned so thoroughly as to make absolutely certain that there are no flammable materials present or any substances such as greases, tars, acids, or other materials that when subjected to heat, might produce flammable or toxic vapors. Any pipelines or connections to the drum or vessel must be disconnected or blanked.

### **8.2 Venting and purging.**

All hollow spaces, cavities or containers must be vented to permit the escape of air or gases before preheating, cutting or welding. Purging with inert gas is recommended.

## **9.0 Cleaning Compounds**

Because of the possible toxicity or flammability of cleaning materials, employees are expected to take appropriate precautions, such as following manufacturer's instructions.

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

## **10.0 Definitions**

**Welding/Hot Works Procedures:** Any activity that results in sparks, fire, molten slag, or hot material, that has the potential to cause fires or explosions.

**Hot Works:** Cutting, Brazing, Soldering, Thawing Pipes, Torch Applied Roofing, Grinding and Welding.

**Special Hazard Occupancies:** Any area containing Flammable Liquids, Dust Accumulation, Gases, Plastics, Rubber and Paper Products.

## Appendix A. Personal Protection Guide

### Eye And Face Protection Selection Guide

1. GOGGLES, flexible fitting, regular ventilation
2. GOGGLES, flexible fitting, hooded ventilation
3. GOGGLES, cushioned fitting, rigid body
- \*4. SPECTACLES, metal frame, with side shields
- \*5. SPECTACLES, plastic frame with side shields
- \*6. SPECTACLES, metal-plastic frame, with side shields
- \*7. WELDING GOGGLES, eyecup type, tinted lenses
- 7A. CHIPPING GOGGLES, eyecup type, clear safety lenses
- \*\*8. WELDING GOGGLES, coverspec type tinted lenses
- 8A. CHIPPING GOGGLES, coverspec type, clear safety lenses
- \*\*9. WELDING GOGGLES, coverspec type, tinted plate lens
10. FACE SHIELD (available with plastic or mesh window)
11. WELDING HELMETS

\* Non side shield spectacles are available for limited hazard use requiring only frontal protection.

\*\* See the following table for filter lens shade numbers for protection against radiant energy.

APPLICATIONS		
OPERATION	HAZARDS	RECOMMENDED PROTECTORS:
ACETYLENE: BURNING CUTTING WELDING	SPARKS, HARMFUL RAYS, MOLTEN METAL FLYING PARTICLES	7, 8, 9
CHEMICAL HANDLING	SPLASH, ACID BURNS, FUMES	2, 10 (for severe exposure add 10 over 2)
CHIPPING	FLYING PARTICLES	1, 3, 4, 5, 7A, 8A
ELECTIRC (ARC) WELDING	SPARKS, INTENSE RAYS, MOLTEN METAL	9,11 (11 in combination with 4, 5, or 6 in tinted lenses, advisable)
FURNANCE OPERATIONS	GLARE, HEAT, MOLTEN METAL	7, 8, 9 (for severe exposure add 10)
LIGHT GRINDING	FLYING PARTICLES	1, 3, 4, 5, 6, 10
GRINDING HEAVY	FLYING PARTICLES	1, 3, 7A, 8A (severe exposure, add 10)
LABORATORY	CHEMICAL SPLASH, GLASS BREAKAGE	2 (10 when in combination with 4, 5, 6, in tinted lenses)
MACHINING	FLYING PARTICLES	1, 2, 4, 5, 6, 10
MOLTEN METALS	HEAT, GLARE, SPARKS, SPLASH	7, 8 (10 in combination with 4, 5, 6, in tinted lenses)
SPOT WELDING	FLYIG PARTICLES, SPARKS	1, 3, 4, 5, 6, 10

## FILTER LENS SHADE NUMBERS FOR PROTECTION AGAINST RADIANT ENERGY

*Shades more dense than those listed may be used to suit the individual's needs.*

Welding Operation	Shade #
Shielded metal-arc welding 1/16 to 5/32-inch diameter electrodes	10
Shielded metal-arc welding 3/16 to ¼-inch diameter electrodes	12
Shielded metal-arc welding 5/16 to 3/8-inch diameter electrodes	14
Gas-shielded arc welding (non-ferrous) 1/16 to 5/32-inch diameter electrodes	11
Gas-shielded arc welding (ferrous) 1/16 to 5/32-inch diameter electrodes	12
Atomic hydrogen welding	10-14
Carbon-arc welding	14
Soldering	2
Torch brazing	3 or 4
Light cutting Up to 1 inch	3 or 4
Medium cutting 1 to 6 inches	4 or 5
Heavy cutting Over 6 inches	5 or 6
Gas welding (light) Up to 1/8-inch	4 or 5
Gas welding (medium) 1/8 to 1/2 -inch	5 or 6
Gas welding (heavy) Over 1/2 -inch	6 or 9

## Appendix B. Welding/Cutting Permit

Date Work to Begin:	Date of Issue:	Date of Completion/Expiration:
Company Name (if contractor):		
Foreman/Supervisor:		Emergency Contact Number:
Phone Number:		Hours of Operation:
Location of Site Where Work is to be Performed: <input type="radio"/> Inside <input type="radio"/> Outside		
<hr/> <hr/>		
Description of Work to be Performed:		
<hr/> <hr/> <hr/>		
Equipment to be Used:		
<input type="radio"/> Electric Arc <input type="radio"/> Acetylene Generator <input type="radio"/> Other _____ <input type="radio"/> Calcium Carbide <input type="radio"/> Gas Cylinders		
Fire Alarm & Detection System Impairment Required?..... <input type="radio"/> Yes <input type="radio"/> No		
Cylinder Storage Required? ..... <input type="radio"/> Yes <input type="radio"/> No		
<input type="radio"/> Inside <input type="radio"/> Outside		
<p>Welding/cutting operations shall be performed in accordance with the requirements established by OSHA, NFPA 51B Standards, and PLU Health &amp; Safety Manual.</p> <p>Compliance with all requirements established in the documents listed in the Health &amp; Safety Manual shall be the responsibility of all personnel performing welding/cutting operations.</p> <p>Emergency Phone Number - <b>ext. 7911</b>    EH&amp;S Manager - <b>ext. 7233</b>    Maintenance Supervisor - <b>ext. 7383</b></p>		
Inspection Date:	Inspection time:	
Maintenance Supervisor or EHS Manager's Signature:	On-site Foreman's/Supervisor's Signature:	

## REQUIRED PRECAUTIONS CHECKLIST

*Fire safety supervisor verifies that the following precautions are taken.*

### **Fire Systems and Equipment**

- o Available sprinklers, hose streams and extinguishers are in service/operable.
- o Hot Work equipment in good repair.

### **Requirements within 35 ft of work**

- o Flammable liquids, dust, lint and oily deposits removed.
- o Explosive atmosphere in area eliminated.
- o Floors swept clean.
- o Combustible floors wet down, covered with damp sand or fire-resistive sheets.
- o Remove other combustibles where possible. Otherwise protect with fire-resistive tarpaulins or metal shields.
- o All wall and floor openings covered.
- o Fire-resistive tarpaulins suspended beneath work.
- o Protect or shut down ducts and conveyors that might carry sparks to distant combustibles.

### **Work on walls or ceilings**

- o Construction is noncombustible and without combustible covering or insulation.
- o Combustibles on other side of walls, ceilings or roofs moved away.

### **Work on enclosed equipment**

- o Enclosed equipment cleaned of all combustibles.
- o Containers purged of flammable liquids/vapors.
- o Pressurized vessels, piping and equipment removed from service, isolated and vented.

### **Fire watch/Hot Work area monitoring**

- o Fire watch will be provided during and for 60 minutes after work, including any coffee or lunch breaks.
- o Fire watch is supplied with suitable fire extinguishers.
- o Fire watch is trained in use of this equipment and in sounding alarm.
- o Fire watch may be required for adjoining areas, above, and below.
- o Monitor Hot Work area for 4 hours after job is completed.

### **Other Precautions Taken**

- o \_\_\_\_\_  
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