

*Welding Orientation  
And  
Safety Packet*



*Portland Community College*

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***Booth Time is***  
***GUARANTEED***  
***To improve academic performance***  
***in***  
***LESS TIME!***

*PCC Welding Facilities*



*Rock Creek Campus BLDG 2- 17705 NW Springville Rd, Portland, OR 97229*



*Oregon Manufacturing Innovation Training Center (OMIC)- 33701  
Charles T Parker Way, Scappoose, OR 97056*



*Maritime Welding Training Center/Vigor Shipyard Swan Island BLDG 10 –  
5555 N Channel Ave, Portland, OR 97217*

## *Required Tool List for all PCC Welding Students*

**Proper protective clothing, equipment and tools are required to work in the welding shop.**

***You must have all your required equipment by the first day of class listed in gray boxes below. Other equipment by the second day of class. Items included on this list will not be checked out from the Tool Room!***

1- Auto darkening & clear lens welding helmet 1- Wire Brush per term 2- Pairs of safety Glasses per term 2 – Flame resistant clothing/Cap- term 2 -- Lineman pliers/cutters 1 – Pair of steel/composite toe work	3 Pairs of leather welding gloves/term 2 -Vice Grips (10WR) pliers 1 – 25-foot tape measure 1 - Slag hammer (If Applicable) 1 - Set of fillet weld gauges 1 – Welding respirators per term
1 - 12" Combination square 1- Leather welder's jacket (Optional) 10 -Sets of ear plugs per term 1 – Leather apron (Optional) 1 - Leather neck protector (Optional) 1 - Set of tip cleaners 1 - Cutting shield with #5 filter lens 1 - Hammer, 3 lb. Blacksmith 1 - Triple flint striker 1- 28" Heavy Duty Tool box (Stanley Bostich) 1- 12" adjustable wrench (crescent wrench) 1 1- 6" speed square 1- 12" speed square 2 - 8" F-clamps 1 - Flashlight 1 - Hex key set 1- 3 ring binder 1- Lineman Pliers 1- Set of Files 1-Metal Scribe	2 - Corner magnets 1 - Soapstone holder w/soap stone 1 - 24-inch framing square 1 – Calculator (TI-30 or equivalent) 4 – 11R Vise Grip Clamps 2 - 4.5" Grinders 6 - 4.5" Grinding disks per term 6 - 4.5" Wire wheels per term 6 - 4.5" Sanding disks per term 1 – Cold chisel and center punch set 1 – Small ball peen hammer (16 ounce)
	<b>Wire Welding (GMAW/FCAW)</b> 1 Welper MIG pliers 1 Pair of MIG Welding Gloves
	<b>TIG Welding (GTAW/Heliarc)</b> 1 - Pair TIG Welding Gloves 1 - Side Cutters or Welper 1 - Stainless steel tooth brush
	<b>Pipe Welding</b> 1- Pipe Liner file

***Reference "Google.com" to determine which Welding Supply store is nearest you. Be sure to let them know that you're a student at PCC and they should give you a 10% discount or better. Veteran students get 10% off Home Depot and Lowes***



**Rock Creek Campus Welding Instructors**



**Lauren Cobb**  
**Welding Instructor**  
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**971-722-7709**



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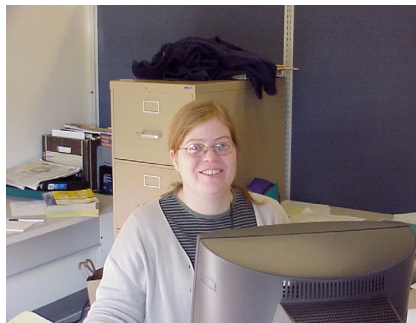
**Rock Creek Campus Support**



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***OMIC Instructor and Staff***



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OMIC 115  
971-722-1805**



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***Swan Island training Center – Vigor -Instructor and Staff***



**Todd Barnett  
Welding Instructor  
Office: BLDG 10 Vigor Shipyard  
503-247-1714**



**Louis Delgato  
Instructional Support Technician  
Office: BLDG 10 Vigor Shipyard  
503-247-1714**

## ***Daily Shop Schedule***

1. Clock in using the attendance system on the computer.
2. Check the chalkboard next to the tool room for specific instructions for the day.
3. Go to your welding station. Review work assignment. Check equipment and area for potential hazards.
4. Check out all equipment needed for the day's work from the tool room.
5. Report any problems with equipment to the instructor or tool room personnel.
6. See your instructor if you have any questions on your work assignment.
7. Use scrap material from bins to adjust your machine and warm up.
8. Prepare material for your work assignment as detailed in your packet or by instructor.
9. Begin welding practice.
10. Continue practice until instructor returns to your station for inspection.
11. If you have been successful in practice, keep the joint for inspection and prepare material for the next project and begin practice. Notify your instructor if a demonstration is needed.

### ***12. Daily Clean-up procedures***

- a. All welding will stop 20 minutes prior to the end of shift.
- b. Remove all metal from welding stations. Quench any hot work prior to depositing it in the proper scrap bin.
- c. Turn off all equipment and lights.
- d. Return all items checked out from the tool room.
- e. Properly store all unused electrodes or filler material.
- f. Thoroughly sweep area and properly dispose of all debris.

### ***13. Weekly Clean-up procedures***

All students will participate in a total shop clean up once a week. Each shift will participate in this on staggered days to ensure that the shop stays clean and safe.

14. Clock out using the computer tracking system.



## *Welding Shop Rules*

1. Conservative utilization of consumable items and materials is critical. Please do not waste material or electrodes.
2. Students are not allowed in the tool room.
3. The student will clean their booth and dispose of the scrap metal at the end of their class. Quench hot metal before depositing into scrap bin.
4. Floor sweepings and slag must be put into the **yellow bins**. Used scrap metal will be put into the **blue bins**. Do not mix aluminum or stainless materials with welded scrap steel.
5. Do not weld or tack materials to the tabletops, stations, or clamps. Anyone caught doing so will be required to grind to it's original surface.
6. ***Safety glasses and approved tinted goggles/face shields must be worn while oxy-fuel cutting or welding.***
7. The use of all power tools must be approved by the instructor.
8. Do not hang, lay, or place electrode holders, burning torches, wire guns except on the hanger provided by PCC.
9. Proper protective clothing must be worn while working in the shop. Do not wear nylon, rayon, etc. type of clothing because these materials will melt to your skin if they catch fire.
10. Unauthorized visitors are not be permitted in the shop.
11. Unprofessional and irresponsible behavior will not be tolerated.
12. **All work will cease during the breaks established by the instructor.**
13. Do not attempt to repair equipment, replace cylinders, or wire spools. Report the problem to your instructor or the tool room personal.
14. **Working in the shop before or after your class period will not be permitted.**
15. No personal projects will be permitted unless first authorized by your instructor.
16. Working or welding on vehicles will not be permitted in the PCC Welding Lab.

17. ***Safety glasses are required at all times in the shop. When cutting, welding, or grinding double protection is required (i.e. face shield or welding hood in addition to safety glasses) [OR OSHA 437-02-283-(2)].***
18. Students will cut practice plates to dimensions specified in training packet or as specified by their instructor.
19. You are responsible for all tools checked out. Return them in working order.
20. Proper care and use of all tools, equipment and facilities is required by all students working in the lab.
21. All students must follow all applicable safety procedures.

***TIG Students:*** Use as much of the TIG metal as possible. The goal is practice not producing the perfect lap or tee. Weld out the entire joint before recycling and don't forget the opposite side of the lap joint practice.



## ***SPECIAL NOTES***

### ***Work Force Requirements***

**Welding is a demanding career. When working in the welding/fabrication field you will be required to lift upwards of 50 pounds, bend and twist in awkward positions for extended periods of time, and work in confined spaces wearing a respirator. Before beginning your educational journey at PCC, I encourage you to research job requirements and see if this fits within your capabilities.**

### ***Academic Dishonesty***

**Cheating on projects, work sheets and/or tests (written or welding) will not be tolerated.**

### ***Alcohol, Marijuana and Other Inhibitors***

**Alcohol, Marijuana, and other Inhibitors are not permitted on PCC's Campus.**

**It is not acceptable to be "medicated" with Marijuana and/or prescription drugs that cause an unsafe mindset and work in the shop.**

**Any indication that you are under the influence of any drugs, alcohol or prescription medication in the PCC Welding Shop will result in immediate dismissal from class that day.**

# *Four Areas of Safety*

*#1 Personal Protection*

*#2 Safe Use of Equipment*

*#3 Operator & Fire Safety*

*#4 Tool Safety*

## **(#1) *Personal Protection***

### **Eyes**

**Safety glasses must be worn at all times.**

Safety glasses are defined as safety lens, safety frames, and hard side shields.



**Sample safety glasses**

Double protection is required when grinding, cutting, and/or welding [OR OSHA 437-02-283-(2)].

**Note:** Full-face shields and most clear cover lens are not made of impact resistance material (polycarbonate).



**Safety glasses will save your eyes!**



## Filter Lens

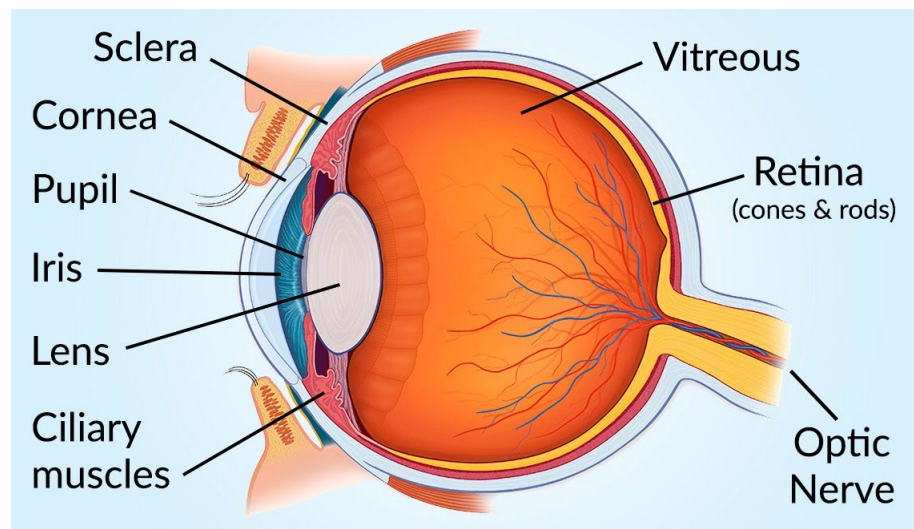
A by-product of electric arc welding is intense visible light, ultra violet & infrared radiation. Welding filter lenses protect the welder's eyes from this hazard.

**Visible Light** is what you see. Too much causes night blindness (poor eyesight under low light levels).

**Infrared Radiation** is felt as heat. This type of radiation is known to cause retinal burning and cataracts.

**Ultraviolet Radiation (UV)** is the MOST DANGEROUS. A welder cannot see or feel this type of radiation. The closer the welder is and the higher the welding current, the quicker the burn will occur.

UV can burn the retina (back of the eye) this can cause some loss of eyesight or burn the whites of the eye causing blisters or scare tissue. Eye cells are killed and can become easily infected. It is these dead eye cells that cause the eye irritation that creates the sand in the eye feeling.



**The Human Eye**

## Filter lens

Filter lens range from a #1 to a #14, with a #14 being the darkest.

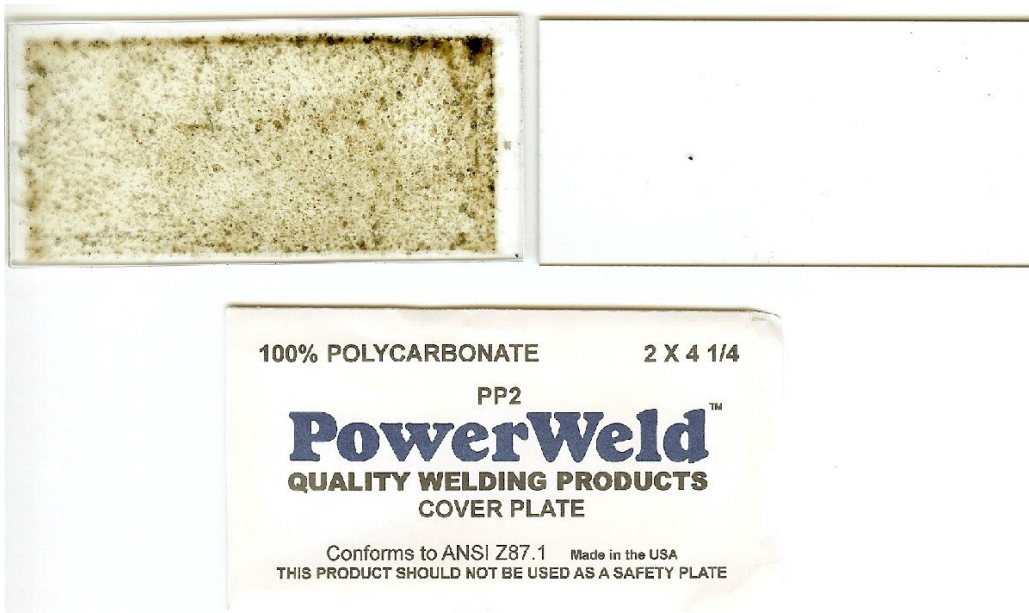
Oxyacetylene Cutting = #4 to #6

Electric arc welding = #9 to #14.

There are many brands of filter lens, you should talk with the instructor or sales representative to determine the best optics for yourself. (common colors: amber, green, cobalt blue, and gold).

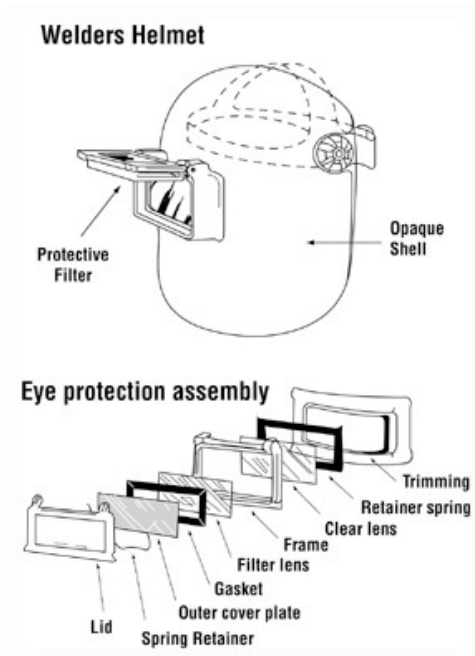


**Sample Filter and Clear Lenses**



**Dirty vs. Clean Cover Lens**

**Make sure to change your lens on a regular basis.**



**Correct placement of the filter lens, clear lenses and gasket are very important for a leak, tight system.**

## Cheaters



A *cheater lens* is a magnifying lens that can be placed in the welding hood to enhance the puddle for those individuals that need corrective vision. ***Have you had your eyes checked lately?***

## *Welding Hoods*

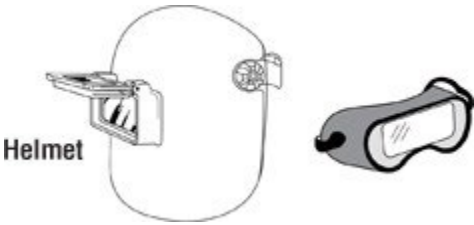

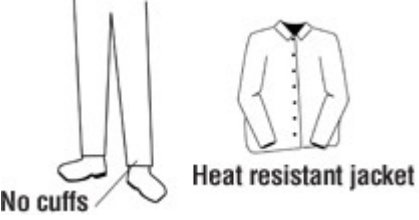



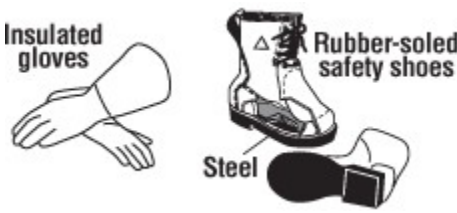


## Proper Clothing



## *Safety* *Personal Protection*

<b>Welding - Personal Protective Equipment</b>			
<b>Body Part</b>	<b>Equipment</b>	<b>Illustration</b>	<b>Reason</b>
Eyes and face	Welding helmet, hand shield, or goggles	 <p style="text-align: center;">Helmet</p>	Protects from: <ul style="list-style-type: none"> <li><input type="checkbox"/> Radiation</li> <li><input type="checkbox"/> hot slag, sparks</li> <li><input type="checkbox"/> intense light</li> <li><input type="checkbox"/> irritation and chemical burns</li> </ul> Wear fire resistant head coverings under the helmet where appropriate
Lungs (breathing)	Respirators		Protects against: <ul style="list-style-type: none"> <li><input type="checkbox"/> fumes and oxides</li> </ul>
Exposed skin (other than feet, hands, and head)	Fire/Flame resistant clothing and aprons	 <p style="text-align: center;">No cuffs      Heat resistant jacket</p>	Protects against: <ul style="list-style-type: none"> <li><input type="checkbox"/> heat, fires</li> <li><input type="checkbox"/> burns</li> </ul> Notes: pants should not have cuffs, shirts should have flaps over pockets or be taped closed
Ears - hearing	Ear muffs, ear plugs	 <p style="text-align: center;">Ear protection</p>	Protects against: <ul style="list-style-type: none"> <li><input type="checkbox"/> noise</li> </ul> Use fire resistant ear plugs where sparks or splatter may enter the

			ear.
Feet and hands	Boots, gloves	 <p>Insulated gloves</p> <p>Rubber-soled safety shoes</p> <p>Steel</p>	Protects against: <ul style="list-style-type: none"> <li><input type="checkbox"/> electric shock</li> <li><input type="checkbox"/> heat</li> <li><input type="checkbox"/> burns</li> <li><input type="checkbox"/> fires</li> </ul>

### Proper Clothing

The best material to wear for welding is tanned leather. This, however, may be impractical. The second-best material to wear as a welder is wool. This too may be impractical given the climate. Therefore, cotton denims are the most popular. For longer life and spark resistance, the cotton clothing should be kept clean and starched after washing. The starch aids in shedding the sparks while cutting and welding.

No man-made fibers, such as nylon and rayon, should be worn at any time while welding. If this material catches on fire it will melt to the skin and must be peeled off, with the skin. Clothing requirements set by the Occupational Safety and Health Association OSHA can be found in OR OSHA 437-02-283 (3).

Clothing should conform to the following basic rules:

- #1 Pants should have no cuffs or frays
- #2 Shirt pockets should have flaps
- #3 Leather work boots (above the ankle) are required.



**Above the ankle leather boots**

#4 A welder's cap should be worn to protect the head. Positioning the cap so that the bill covers the "near side ear" will give added protection.

#5 Leather jacket or sleeves should be worn for vertical and overhead (out of position) welding

#6 Leather type of welding gloves are required.

#7 Make certain that all personnel and flammable materials (i.e. lighters and matches) are clear when working in the welding lab. Students shall not carry matches/lighters on their person, these articles should be stored in the lockers

\*\*Remember welding creates a tremendous amount of heat, sparks, and intense light that the welder needs to protect him/herself from.





## #2 Safe Use of Equipment

### Care and Safe Use of Oxygen and Acetylene Equipment

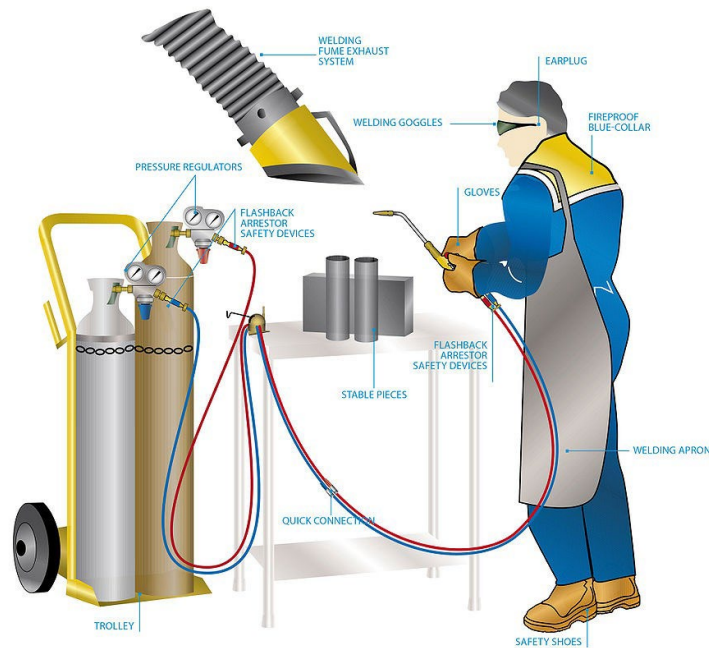
Acetylene Cylinder  
Black Tank



Oxygen Cylinder  
Green Tank

Oxygen and Acetylene Facts

### Correct and safe oxygas welding station



## *Oxygen and Acetylene Data*

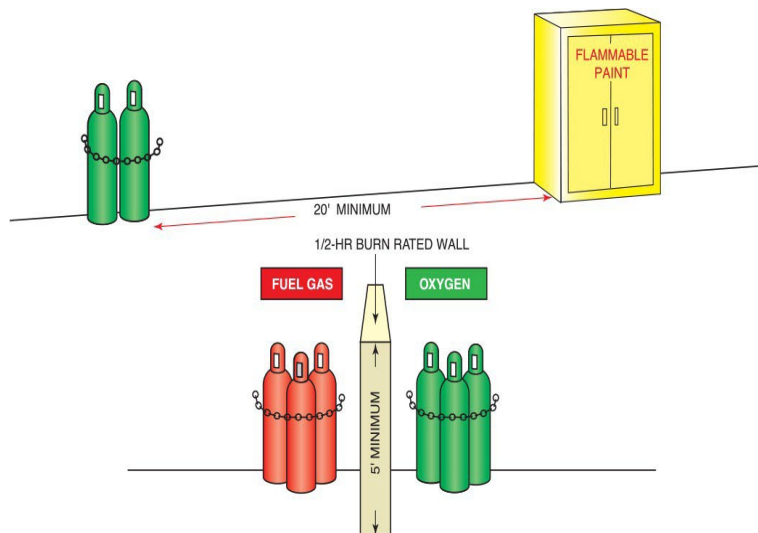
<b>Oxygen Gas</b>	<b>Acetylene Gas</b>
<ul style="list-style-type: none"><li><input type="checkbox"/> Chemical symbol O<sub>2</sub></li><li><input type="checkbox"/> Colorless gas</li><li><input type="checkbox"/> No odor</li><li><input type="checkbox"/> 99.995% pure oxygen as compared to the 21% oxygen in the air we breathe. A minimum of 19.5% and a maximum of 24% is needed to sustain life.</li><li><input type="checkbox"/> Stored as a high-pressure gas (2200 psi is an extreme amount of “stored energy”).</li><li><input type="checkbox"/> Cylinder is made of one piece of steel and is hollow.</li><li><input type="checkbox"/> Oxygen does not burn, but it <b><i>Accelerates Combustion.</i></b></li><li><input type="checkbox"/> Use no oil to lubricate fittings.</li><li><input type="checkbox"/> Safety blow out disk is actuated by pressure.</li><li><input type="checkbox"/> The valve should be either <b><i>fully open</i></b> or <b><i>fully closed.</i></b></li></ul>	<ul style="list-style-type: none"><li><input type="checkbox"/> Chemical symbol C<sub>2</sub>H<sub>2</sub></li><li><input type="checkbox"/> Colorless gas</li><li><input type="checkbox"/> Odor – A pungent garlic type odor.</li><li><input type="checkbox"/> Unstable gas -- <b>MAXIMUM PRESSURE 15 PSIG.</b></li><li><input type="checkbox"/> Low pressure cylinder (250 psi)</li><li><input type="checkbox"/> Cylinder construction has a multiple piece shell welded together.</li><li><input type="checkbox"/> Cylinder Contents <b>Core-</b> Porous Filler (microscopic sponge) Occupies 8% to 10% <b>Acetone</b> Occupies 42% <b>Acetylene</b> Occupies 36% <b>Reserve Volume</b> at 70F 10-12%.</li><li><input type="checkbox"/> <b><i>The valve should not be opened more than 1 ½ turns.</i></b></li><li><input type="checkbox"/> The Fusible Safety plug is actuated by heat. It will melt at approximately 212F.</li><li><input type="checkbox"/> Explosive limits in O<sub>2</sub> --- 3.0% to 93%</li><li><input type="checkbox"/> Explosive limits in Air --- 2.5% to 88%</li></ul>

## Handling and Storing Cylinders

**PCC Welding utilizes three separate rooms to store cylinders of Argon, CO2 and Acetylene gas. These rooms comply with fire safety standards.**



- Store all cylinders vertically.
  - Valve protection caps must be utilized when cylinder is not in use (i.e. does not have a regulator attached to it).
  - Cylinders should not be transported by their valve caps.
  - Cylinders must be stored and chained upright.
  - When safety precautions refer to acetylene, the precautions are equally applicable to other fuel gasses, such as natural gas, propane, chem-o-lene, hydrogen, etc.
  - Never use a cylinder or its contents for other than its intended purposes.
  - Keep cylinders away from exposure to sparks, hot slag, open flame and all possible sources of excessive heat.
  - Never strike an arc on a cylinder. This will render the cylinder useless.
  - Take care never to place cylinders in passageways for people or equipment.
  - Do not lay a lit torch down or leave unattended (includes track cutters).
  - Do not use oxygen in place of compressed air.
  - Do not burn over concrete without first protecting it with a piece of scrap sheet metal.
- 
- Oxygen and fuel gas cylinders or other flammable materials must be stored separately.
  - The storage areas must be separated by 20 ft (6.1 m), or by a wall 5 ft (1.5 m) high, with at least a 30 minute (min) burn rating,
  - Empty (MT) cylinders must be stored separately from full.



- Always secure cylinders upright to a suitable support with a chain. Ensure that there is no metal to metal contact between the weldment and the cylinder.
- Do not store cylinders in unventilated areas.
- Always transport, store and use acetylene cylinders in the vertical position to avoid drawing off the acetone that is in the cylinder.

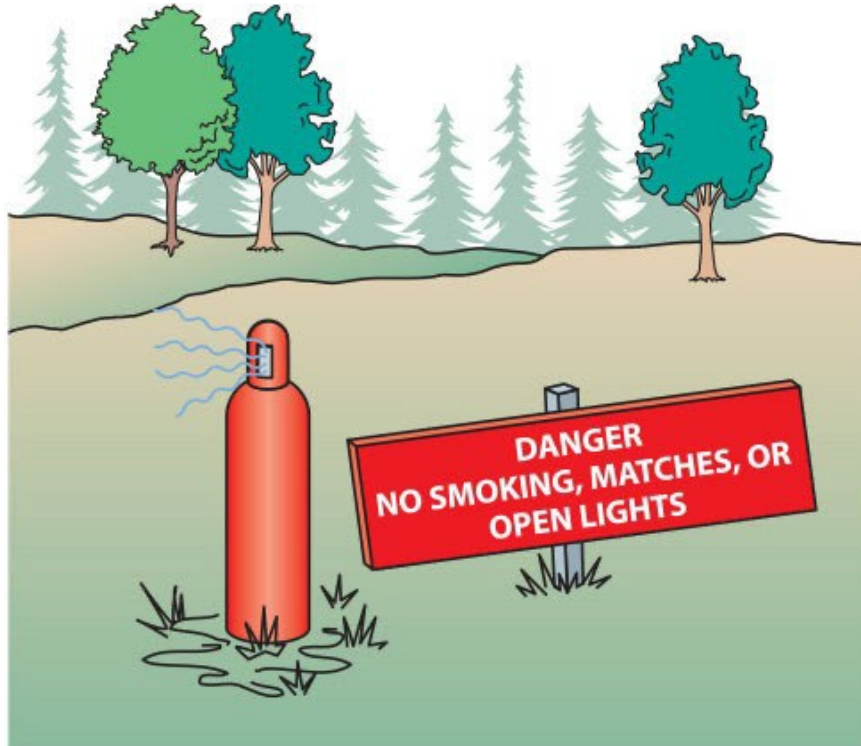


**WHAT NOT TO DO**

**The acetylene cylinder standing but the valve protection cap is not on and the oxygen cylinder lying down.**

- Acetylene cylinders that have been lying on their sides must stand upright for 4 hours or more before they are used.
  - The acetylene is absorbed in acetone, and the acetone is absorbed in a filler.
  - The filler does not allow the liquid to settle back away from the valve very quickly.
- Never use cylinders as supports or rollers.
  - Never try to mix any gasses in a cylinder.
  - Never try to refill a cylinder.
  - Mark empty cylinders empty ("MT") and date it.
  - Store empty and full cylinders in a separate location.
  - If leaks are found in acetylene cylinder valves, or if leaks are found at acetylene fuse plugs or in cylinder, shut the system down and notify your instructor.





**Leaking acetylene cylinder should be set out side and labeled.**

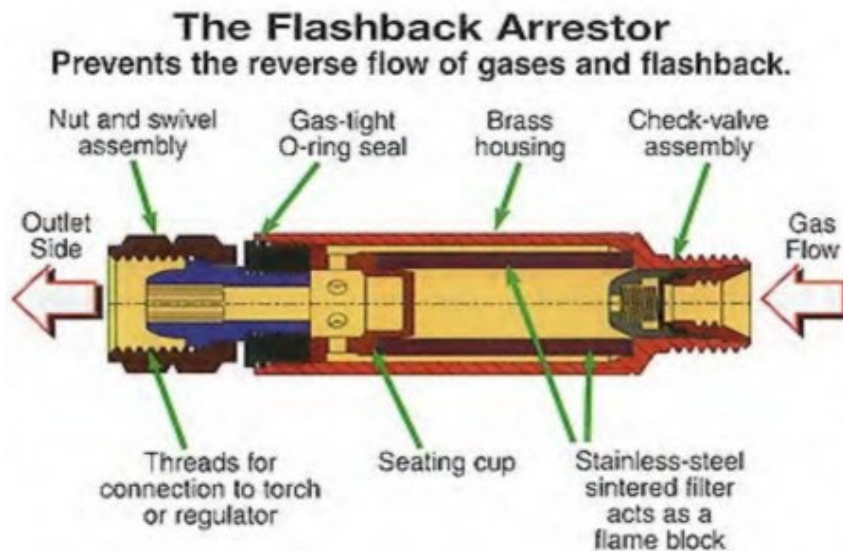
- If the leak cannot be stopped by closing the cylinder valve, the cylinder should be moved to a vacant lot or an open area.
  - The pressure should then be slowly released after posting a warning sign.
- Protect cylinder valves from bumps, falls, falling objects, and from weather. Keep them covered with cylinder cap when moving cylinders.
- Keep valves closed on empty cylinders.

## Regulators

- Never connect a regulator to a cylinder containing a gas other than that for which the regulator is designed.



- If a regulator shows excessive creep (pressure building up when torch valves are closed), replace it.
- The gases used on oxy-acetylene applications should never be drawn from cylinders except through properly attached pressure regulators approved for oxygen or acetylene service.
- Flashback Arrestor



## Hoses

Hoses follow the following color system:

- Acetylene = Red = Left Hand Thread, Notched fittings



- Oxygen = Green = Right Hand thread
- Inert Gas = Green or Black = Right Hand Thread

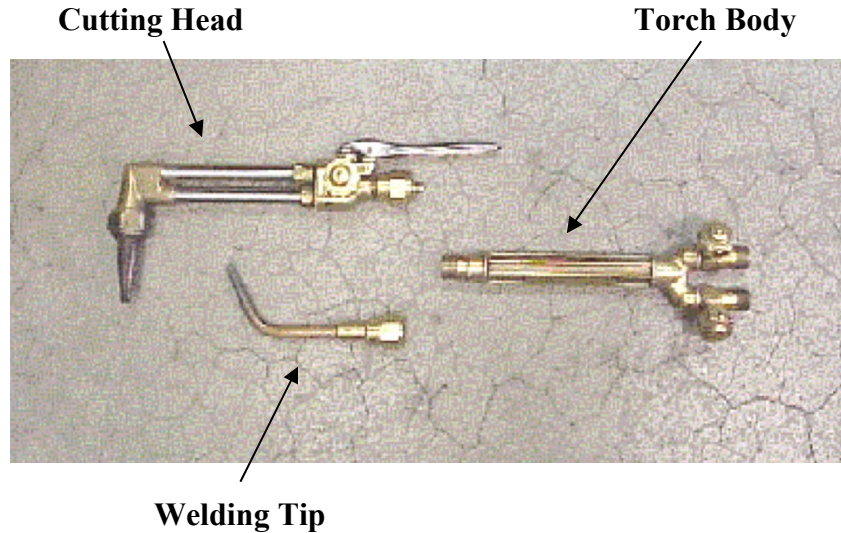
Use only hoses designed for use with the gas source to which it is to be connected. Do not interchange fittings on hoses or use other than standard hose fittings.

- Never use ordinary wire as a binding in making hose connections. Use binders or clamps designed for hose use.
- Use only standard brass splices for splicing hose--never use copper tubing for this purpose.
- Keep hoses away from grease, oil and water.
- Protect hoses from sparks, hot slag, hot objects, sharp edges, and open flame.
- If a hose is burned by a flashback, discard that length of hose. A flashback burns the inner walls and renders the hose unsafe.
- Examine all hoses for leaks, worn places and loose connections prior to use. Acetylene escaping into the atmosphere may start a serious fire or explosion. **Do not repair hoses with tape, see your instructor for assistance.**
- Gas should not be left under pressure because it can migrate through the hose walls with Siamese hoses.



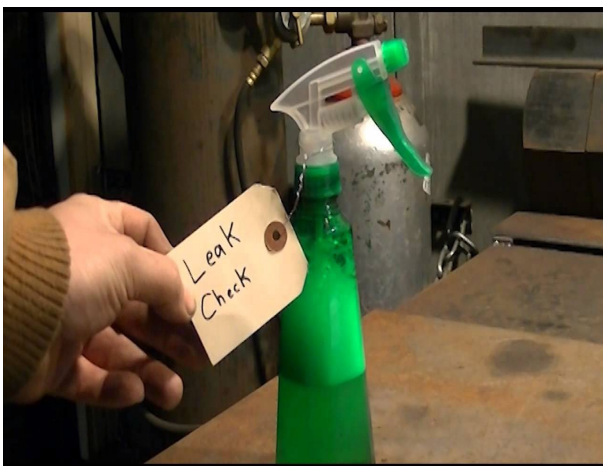
Regulator Blow Out (also known as a Valve Seat Fire)

## Torches



### Victor Combination Torch Set

- Leak check equipment before using by pressurizing the system and then turning off the main cylinder valves. If regulator pressures drop, there is a leak in the system. This is known as the pressure drop check. The system then can be sprayed with leak detector solution to locate leak(s). Bubbles will indicate the leaks.
- Use no oil on any fittings
- Ensure hoses have no leaks, rips, tears, etc.
- Always inspect equipment before using. Do not work with defective equipment.
- Inspect union nut connections and all seating surfaces on regulators and torches before use. Damaged connectors should be removed and faulty seats repaired; they are apt to cause backfires or flashbacks.



## ***BACKFIRES AND FLASHBACKS***

A **backfire** is a loud pop associated with the momentary extinguishment and re-ignition of the flame at the torch tip.

It may be caused by:

- Touching the tip against the work
- Particles entering the tip and obstructing the gas flow -- Dirty Tip
- Overheating the tip - too close to the work
- Improper gas pressure adjustment (too "lean" of a mixture - not enough fuel gas)
- Loose Tip
- Damaged Seats

Sometimes the trouble will clear itself immediately, and if the work is hot enough, the torch will re-light automatically. If this happens, close oxygen torch valves immediately (cutting and then pre-heating valve). Close the acetylene valve. Inspect the system to determine the cause (i.e. check pressures, clean tip, ensure hoses are straight). If the student can not determine the cause s/he should check with his/her instructor. Then re-light, using standard lighting procedures, which includes purging the hose lines. Before re-lighting, check your pressure.

A **flashback** is the recession of the flame into the tip, torch or the hose, if an explosive mixture is present in one of the lines. It is sometimes accompanied by a hissing or squealing sound and a characteristic smoky or sharp pointed flame. This condition necessitates extinguishment of the flame by closing the torch oxygen valve first and then the torch acetylene valve. Wait a few moments to ensure the fire in the torch or hose has a chance to be extinguished.

Flashbacks can be caused by:

- Failure to purge lines
- Improper pressures
- Distorted or loose tips or mixer seats
- Kinked hose, clogged tip or torch orifices
- over heated tip or torch.

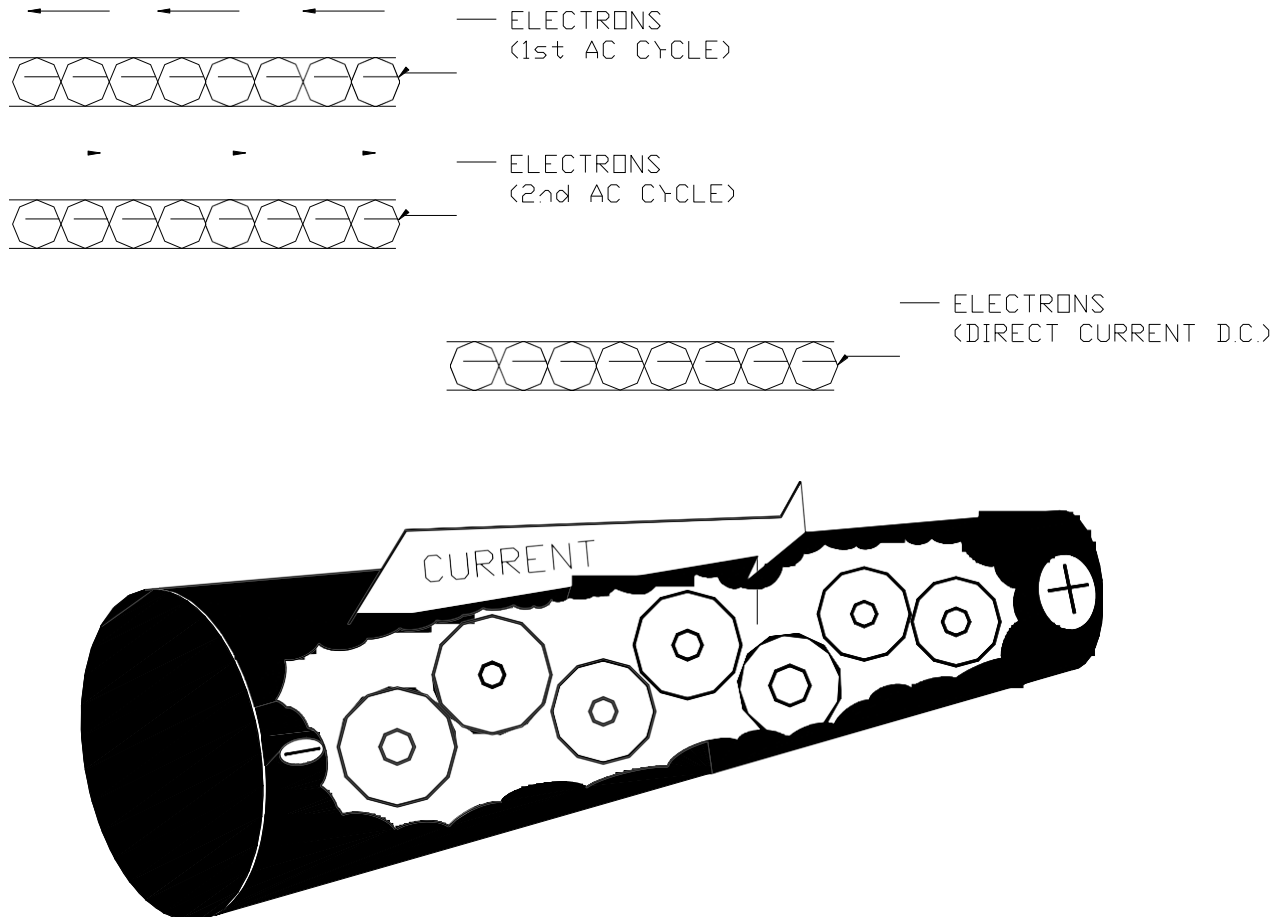
See your instructor if you have repeated backfires or flashbacks.



## *Arc Welding Basic Electricity*

*(Courtesy of Miller Electric)*

Electricity is defined as the movement of electrons along a conductor. When referring to Alternating current (AC), electrons move in two directions. In direct current (DC), the electrons move in one direction.



**In welding, the study of electricity is based on current flow from negative to positive. This is known as the “Electron Theory.”**

## Three Basic Elements in Electricity

(Courtesy of Miller Electric)

### Electromotive Force (Voltage)

The electromotive force (EMF) pushes and pulls electrons (current) through the conductors in an electrical circuit.

When one volt of EMF is applied to a circuit a certain number of electrons are freed from their atomic structure. When the voltage is increased to two volts, twice as many free electrons will travel through the circuit.

One volt is defined as the pressure that will force one ampere of current through a resistance of one Ohm.

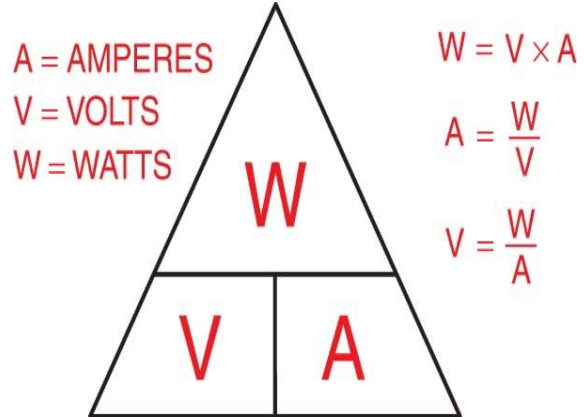
### Current

The ampere is a unit of electrical current flow created by a progressive movement of free electrons along a wire or other conductor. The electron movement is shown in the adjacent picture.

### Resistance

Resistance refers to an opposing effect that hinders free electrons progressing through wires when the EMF is attempting to produce current in the circuit.

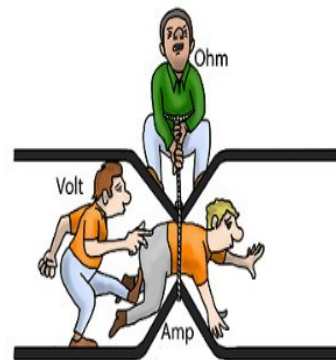
The basic unit of resistance of a conductor are the length, cross sectional area, temperature and the type of the conductor used.



Impulse of Striking Force



The impulse of energy is transferred from one electron to another almost instantaneously. Thus current flows at approximately 186,000 miles per second, the speed of light.



Quantity	Symbol	Unit of Measurement	Unit Abbreviation
Current	I	Ampere (Amp)	A
Voltage	V or E	Volt	V
Resistance	R	Ohm	Ω

**Four Common Types of Welding Machines.**



**Gas Tungsten Arc Welder**



**Gas Metal Arc Welder**



**Flux Cored Arc Welder**



**Shielded Metal Arc Welding**

## ***ARC WELDING SAFETY***

- Electricity follows the path of least resistance.
- Greatest shock potential is when high voltage is present. Voltage is defined as the driving force. It is this force that is needed to break past the resistance barrier, thus resulting in an electrical shock.
- The electrode and the work (ground) circuits are electrically "hot" when the welder is on. Do not touch these "hot" parts with your bare skin or wet clothing. Wear dry, hole free gloves to insulate hands.
- Always be sure the work cable makes a good electrical connection with metal being welded.
- Maintain the stinger, ground clamp, welding cable and welding machine in good safe operating condition.
- Ensure you are not wet (low resistance).
- If machine needs repair contact instructor.
- Keep all connections tight and well maintained.
- Ensure machine is off prior to repairing unit.
- Safe work habits and conditions are everyone's responsibility.
- Keep your work area clear of combustibles.



### ***DO NOT PUT COMBUSTIBLES ON TOP THE WELDER***

- Be sure that the machine is properly grounded.
- Do not use pipelines carrying gasses or flammable liquids or conduits carrying electrical conductors for grounding purposes.
- Never change the polarity switch when the machine is on. This will destroy the switch contact.
- Do not let the electrode holder touch any metal that contacts the welding ground.
- Make sure the jaws of the electrode holder are tight.
- Keep all connections of the electrode leads tight.
- Do not overload welding cables or operate with poor connection.
- Never strike an arc on a compressed gas cylinder.
- Do not work in a damp area.
- Keep hands, clothing and work area dry at all times.

## #3 Operator and Fire Safety

Beware of hazards around you while welding:

- o Fuel -- Gas, Diesel, Paint thinner, Etc.
- o Flammables on your person
  - o Lighters
  - o Matches
  - o Oily coveralls

What are you welding on:

- o In or on a vessel (Tank)
- o Galvanized material
- o Cadmium cover bolts
- o Painted steel (lead)
- o Know the type of metal and their fumes/particulates

Welding in closed or confined places depletes breathable air. Always make sure there is plenty of fresh air from blowers, air lines or other means. Never use *compressed oxygen* for ventilation.

When toxic fumes from painted surfaces, lead, cadmium bearing materials or any other substances are present in harmful concentrations, always use an air-supplied respirator.

Never operate a gasoline powered welder in a confined area. Carbon monoxide created by the welder's exhaust will kill or seriously injure you before you know what has happened.

Know where safety equipment is located

- o Fire extinguisher
- o Fire blanket
- o Fire Alarm
- o First aide equipment
- o Telephone (Do you know your location?)
- o On/Off Switches for equipment
- o Are you First Aide & CPR Trained, or is anyone that's working around you qualified





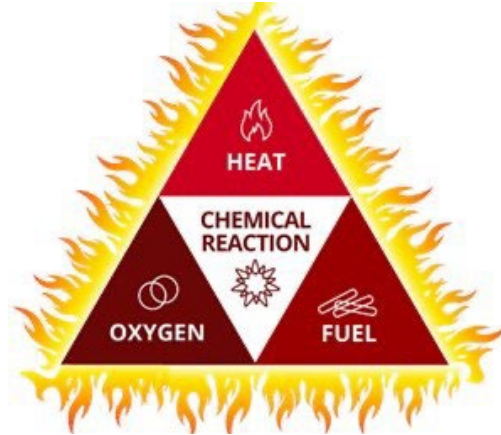
# Fire Safety

A fire needs three items to maintain its combustion. These items are best described by using the fire triangle.

## Fire Triangle

**Heat**  
Friction  
Heat of recompression  
Sparks  
Flame

**Oxygen**  
Air = 21% oxygen  
Welding Grade = 99.995%



**Fuel**  
Hydrocarbons\*  
Oil  
Grease  
Acetylene

*Note that Oxygen does not burn, but it does accelerate combustion.*

\*Hydrocarbon is defined as any of a large class of organic compounds containing only carbon and hydrogen

To extinguish a fire it is necessary to remove one of the legs in a fire triangle. This can be accomplished by using the correct type of fire extinguisher based on the type of fire. A fire extinguisher is a storage container for an extinguishing agent such as water or chemicals. It is designed to put out small fires not large ones.

An extinguisher is labeled according to whether the fire on which it is to be used occurs in wood or cloth, flammable liquids, electrical, or metal sources. Using one type of extinguisher on another type of fire can make the fire much worse. An example of this would be to attempt to put out a kitchen grease fire with water. If you recall in your elementary school training, to extinguish this type of fire it is best to smother it with a lid. By doing this, the oxygen leg in the fire triangle is eliminated, thus extinguishing the fire.

Most commonly, welding facilities are equipped with ABC fire extinguishers. This type will put out ordinary combustibles, flammable liquids and electrical fires. It's important to know where these extinguishers are located to reduce the response time when necessary. See the pictogram chart for further explanation.



Not all fires are the same, and they are classified according to the type of fuel that is burning. If you use the wrong type of fire extinguisher on the wrong class of fire, you can, in fact, make matters worse. It is therefore very important to understand the four different fire classifications.



**Class A - Wood, paper, cloth, trash, plastics**  
Solid combustible materials that are not metals. (Class A fires generally leave an Ash.)



**Class B - Flammable liquids: gasoline, oil, grease, acetone**  
Any non-metal in a liquid state, on fire. This classification also includes flammable gases. (Class B fires generally involve materials that Boil or Bubble.)



**Class C - Electrical: energized electrical equipment**  
As long as it's "plugged in," it would be considered a class C fire. (Class C fires generally deal with electrical Current.)



**Class D - Metals: potassium, sodium, aluminum, magnesium**  
Unless you work in a laboratory or in an industry that uses these materials, it is unlikely you'll have to deal with a Class D fire. It takes special extinguishing agents (Metal-X, foam) to fight such a fire.



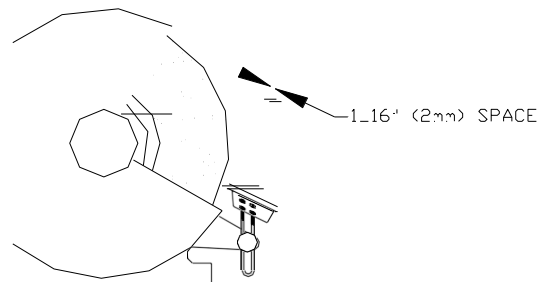
**Classification of Fuels**

Most fire extinguishers will have a pictograph label telling you which classifications of fire the extinguisher is designed to fight. For example, a simple water extinguisher might have a label like the one below, indicating that it should only be used on Class A fires.



## #4 Tool Safety

### Pedestal Grinder



- Always wear safety glasses and a clear face shield

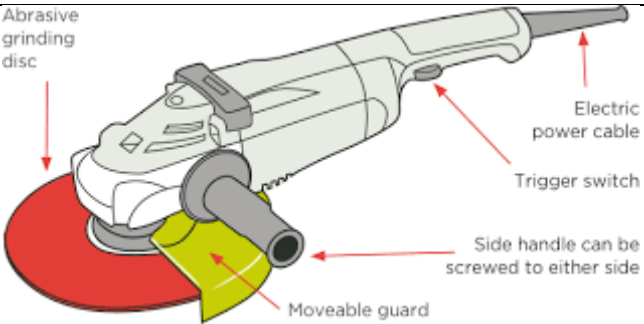




## **Pedestal Grinder**

- The tool rest must be fastened securely with about a 1/16 inch of clearance between it and the wheel. A maximum clearance is 1/8 of an inch.
- Never install a grinding wheel. See your instructor for instruction.
- Ensure that no one is inside the operator's zone while you are operating the grinder. Ear plugs (hearing protection) are recommended.
- Always check a grinding wheel for cracks, defects, or impregnated aluminum prior to use.
- Use the correct type of grinding wheel. There are different wheels designed to grind aluminum.
- Ensure the tongue guard is in place and securely fastened.
- Ensure the grinder has a true, balanced, and dressed wheel. Notify the instructor if the wheel needs to be dressed.
- Stand to one side of the grinder when turning it on.
- Move back and forth across the cutting surface (FACE of the grinding wheel), to keep the wheel from being grooved.
- Never grind on the side of a wheel in the PCC Welding Lab.
- Keep the work cool by quenching it in the water tank.
- Press work material against the wheel using a fair amount of pressure. Do not overload the machine.
- Remember to turn the grinder off immediately after you are done.

## Hand Grinder

- Use proper eye and face protection-- safety glasses and a clear face shield.
- Earplugs are required.
- Use screens to prevent showering others with sparks and assorted pieces of steel made airborne by the grinder.
- Ensure the wheel guard is securely fastened, and utilize the side handle when operating this piece of equipment.
- Grinding disks must be designed for the material being ground and must be rated for a "safe speed" at least as high as the no load RPM marked on the nameplate.
- Do not carry a plugged-in tool with your finger on the switch. Ensure the switch is disengaged before plugging it in. Do not utilize the "Suicide Switch."
- Do not abuse the cord. Take special precautions to keep it away from the grinding wheel.

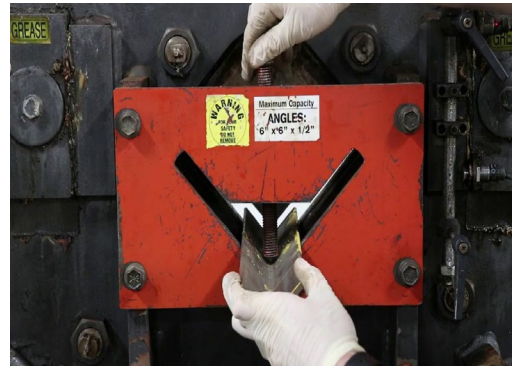
<p>Nomenclature of an angle grinder</p>	
<p>4.5 inch grinder</p>	
<p>7 inch grinder</p>	



## Ironworker Shear

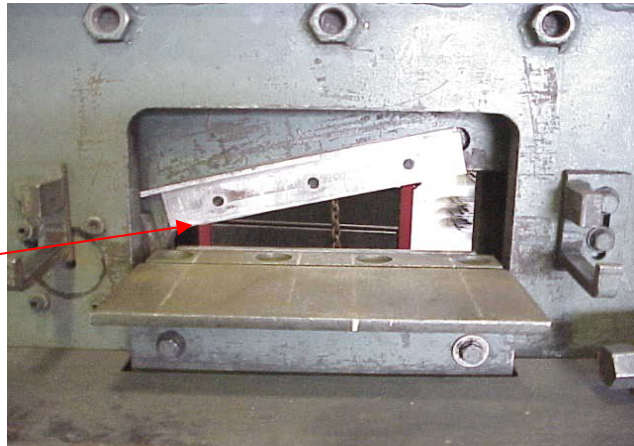
There are many types of ironworkers being used in industry today. Pictured below are two such units that a welder may be required to use. It is essential for welding personnel to read through the operator's manual or obtain training to familiarize yourself with the equipment to use it safely and efficiently. Listed below are common safety rules that will apply towards ironworkers.

- Do not exceed material thickness, and hardness capacity of shear.



- Edwards shear cutting capacity
  - 3/8" x 24" flat bar
  - 1/2" x 14" flat bar
  - 1" x 4" flat bar
- Do not cut through welds with shears, this may cause damage to the shear blades.
- Never cut across flame cut edges, or through slag or weld spatter. Clean off any slag, and grind all flame cut areas where shearing will occur.

**Pivot point (*Throat*)**



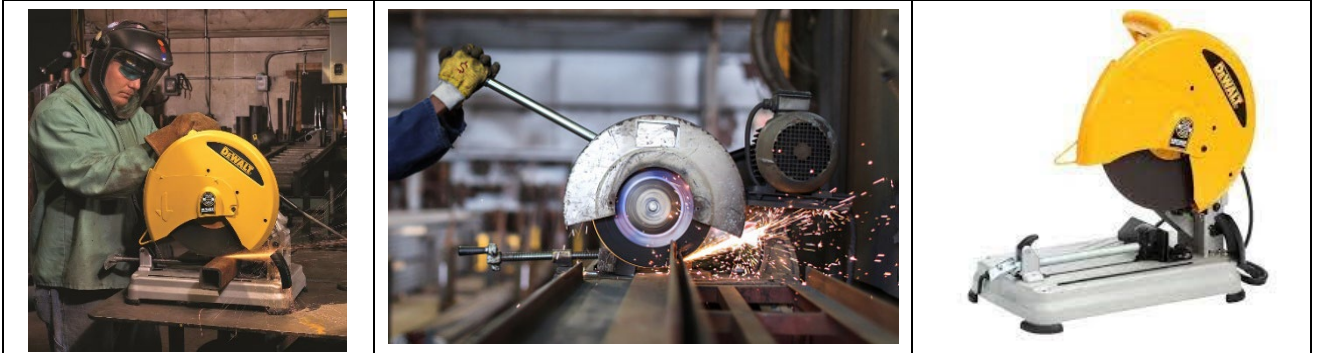
- Maximum power efficiency is obtained by placing the metal as close to the pivot point (throat) as possible. Special Note: The Edwards ironworker cuts material similar to a galantine. The placement of the material is not as critical as compared to ironworkers that use a pivot point system.
- Keep fingers and hands away from the shear blade and moving parts when operating the shear. When shearing a large section of metal, the operator is responsible for the helper.
- When cutting small metal pieces, use larger pieces of metal as a support for holding the small piece securely in position.
- Turn the shear off immediately after use, and before retrieving any sheared (cut) pieces.
- See manufacturer's instructions for changing machine function from shearing to punching.

## Horizontal Band Saw



- The band saw machines should have all guards in place and be in working condition.
- The operator should always keep his/her hands clear of the blade. Care should be taken when loading parts in the band saw to prevent injury from moving parts.
- Use some type of supporting device for the material drops, whether long or short.
- Never reach or position any part of your body under a saw blade. Someone could start the machine, or a malfunction could cause the cutting head to drop.
- Never wipe or clean off parts that are being sawed. The rag could catch on the saw blade, and pull the operator's hand into the moving blade.
- Always turn off the machine when it becomes necessary to adjust or change the blade.
- Always keep the floor and work area around the machine free from debris, oil, and coolant slicks.
- A saw blade, which has been removed from service and coiled, should always be tied with wire to keep it from rapidly uncoiling.
- Make sure the blade has come to a complete stop before opening the cover for any reason.
- When changing saw blades, always close the cover before applying the final blade tension.
- Do not cut material that is hot. This will damage the blade and the band saw bed.
- Hand feed the saw blade into the work initially. This will prevent blade damage.
- Machine is designed to stop automatically at end of cut. Be sure it actually has stopped before reloading.
- Never load the machine while it's running.
- Never adjust guide arms while blade is running.
- Always wear eye protection when attending and operating machine.

## *Chop Saw*



- Keep guard in place and in working order.
- Keep work area clean.
- Do not force the tool. It will do a job better and safer at the rate of which it was intended.
- Wear proper apparel. No loose clothing, gloves, neckties, rings, bracelets or jewelry because it can get caught in the moving parts.
- Double protection is required. Safety glasses with face shield.
- Disconnect tools prior to changing accessories such as cutting wheel.
- Always hold the work firmly against the fence.
- Be sure cut off saw is sharp, free cutting and free from vibration.
- Raise the cut off saw free from kerf prior to releasing the trigger switch.
- Allow motor to reach full speed before cutting.
- Use only cut off saw blades with speed rating at least as high as the revolutions per minute (RPM) specified on the nameplate.
- Do Not place either hand in the working area when the tool is connected to the receptacle.

## *Welding Safety Worksheet*

NAME \_\_\_\_\_ DATE \_\_\_\_\_

DIRECTIONS: Answer the questions listed below. Refer to the information sheets and Welding Principles and Applications, if needed.

### **Define the following terms:**

1. Flashback Arrestor

2. Backfire

3. Flashback

### **True or False**

4. T F It is acceptable to use oxygen from the cylinder for ventilation.
5. T F It is acceptable practice to dust off your clothes with oxygen.
6. T F Acetylene cylinders must be stored and transported in the upright position.
7. T F An easy and safe way to locate a leak in an oxy-acetylene system is with a flame.
8. T F If a regulator squeaks it should be given a squirt of oil.
9. T F The red hose is the oxygen hose.
10. T F The acetylene connections have left hand threading.
11. T F If a hose leaks, wrap it up with tape.
12. T F You may change the polarity while an operator is welding.
13. T F The amperage may be adjusted while the operator is welding.
14. T F Electrodes must be consumed to a 2-inch stub length.
15. T F Students may go into the tool room at will.



16. T F The bench rest on the pedestal grinders should have a maximum clearance of 1/8 inch.
17. T F You may invite visitors to watch you weld.
18. T F Gas tanks are repaired and welded in the PCC shop.
19. T F Stand to one side of the regulator when opening the cylinder valve.

**Multiple Choice**

20. The average person should use what shade filter lens for arc welding?  
a. #5      b. #10      c. #15      d. #4
21. Exposure to the ultraviolet rays of an electric arc can cause:  
a. skin cancer                      c. painful eye burns  
b. painful burns to the skin      d. all of the above
22. The only metal that can be ground on the pedestal grinders is:  
a. aluminum                      c. steel  
b. silicon                          d. none of the above
23. What is the maximum safe working pressure for acetylene?  
a. 5 psig      b. 10 psig      c. 15 psig      d. 35 cfh

## *PCC Welding Safety Test*

Name: \_\_\_\_\_

Date: \_\_\_\_\_

1		19	
2		20	
3		21	
4		22	
5		23	
6		24	
7		25	
8		26	
9		27	
10		28	
11		29	
12		30	
13		31	
14		32	
15		33	
16		34	
17		35	
18			

*I have received and understand the information contained in the welding program safety packet.  
I have read the entire packet and completed the safety test. I will contact my instructor about any  
instructions that I do not fully understand.*

Signed: \_\_\_\_\_ Date: \_\_\_\_\_

**Student Information**

Name: Pronouns (Optional)	G#
Address	
Home Phone	Bus. Phone
<p><i>I have received and understand the information contained in the welding program safety packet. I have read the entire packet and completed the safety test. I will contact my instructor about any instructions that I do not fully understand.</i></p> <p>Signed: _____ Date: _____</p>	
Emergency Name and Phone	

**PCC Welding Attendance Agreement**

Welding Class(es)	Credit Hours	Clock Hours
Hours calculation 1 credit = 20 class hours, 2 credits = 40 class hours, 3 credits = 60 class hours, 4 credits = 80 hours and so on.....	<b>Total Hours</b>	

**Attendance Days and Times**

	Monday	Tuesday	Wednesday	Thursday
<b>Times</b>				
<b>Initials</b>				
<b>Initials</b>	<b>Policies</b>			
	<p><i>I understand that my grade is dependent upon attending class on the days and times indicated above. I understand that the instructor is like an accountant! He only adds up and divides out the student's grade based on the student's performance and attendance. I understand that there are no "excused absences". Hence, EXCESSIVE ABSENCES will negatively affect the grade I earn.</i></p>			
	<p><i>I understand that as a student that it is my responsibility to track my personal academic progress on MyPCC.</i></p>			
	<p><i>I have read the entire syllabus, and I understand how my performance will be assessed.</i></p>			
	<p><i>I authorize Portland Community College to record my likeness and performance on film or electronic media; and at their discretion to use and authorize others to use my likeness for student recruiting, fund raising and publicity purposes.</i></p>			
Student's Signature:	Date			



Public Affairs

I, \_\_\_\_\_  
(Print Name)

Herby authorize Portland Community College to record my likeness and performance on film or electronic media; and at their discretion to use and authorize others to use my likeness for student recruiting, fund raising and publicity purposes.

\_\_\_\_\_  
(signed)

\_\_\_\_\_  
(Date)