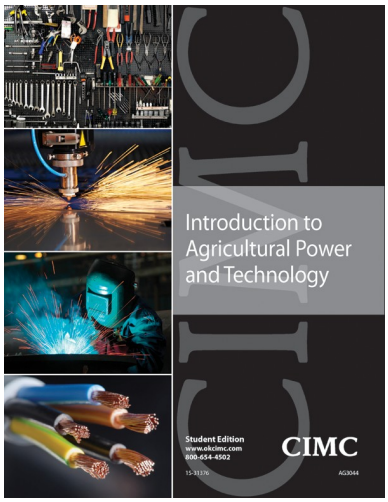
Introduction to Agricultural Power and Technology



Introduction to Agricultural Power and Technology is based on the Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards. Students typically take this course after completing Introduction to Agriscience, also known as Agricultural Education I. The book is intended to build upon many of the concepts learned from *Agriscience Explorations* (AG1017) and *Introduction to Agriscience* (AG1001).

The student book and teacher books are both full-color. The teacher book is printed in a wrap-around format and includes suggested activities and websites. The teacher resource CD includes printable Assignment Sheets, Activity Sheets, and Lab Sheets, written tests in Word, PDF, and RTF (to be used with ExamView) formats, PowerPoints for each unit, project grading rubrics, and OSHA fact sheets.

Units include:

- General Safety
- Hand and Power Tools
- Welding and Cutting Safety
- Oxyfuel Applications
- Plasma Arc Cutting
- Welding Fundamentals
- Shielded Metal Arc Welding
- Gas Metal and Tungsten Arc Welding
- Agricultural Construction and Fabrication
- Electrical Tools and Safety
- Electricity Principles
- Engine Safety and Maintenance
- Geospatial Technologies

We are offering Unit 3, "Welding and Cutting Safety," as a free sample to download.

Introduction to Agricultural Power and Technology
2015
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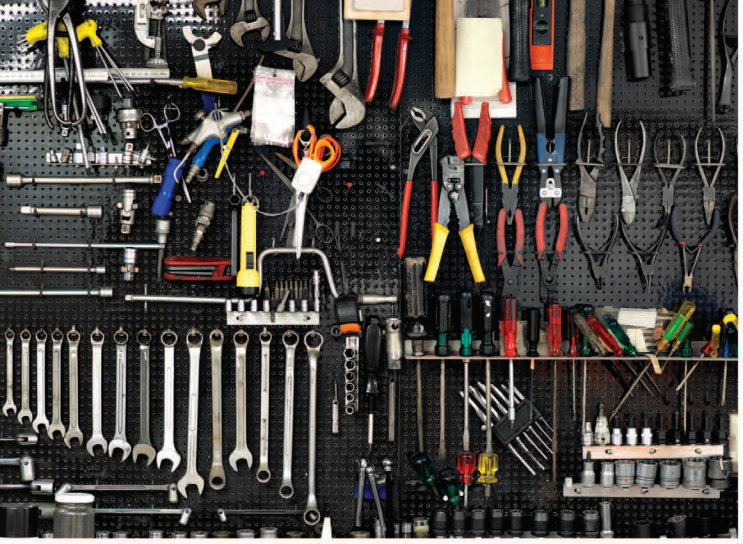

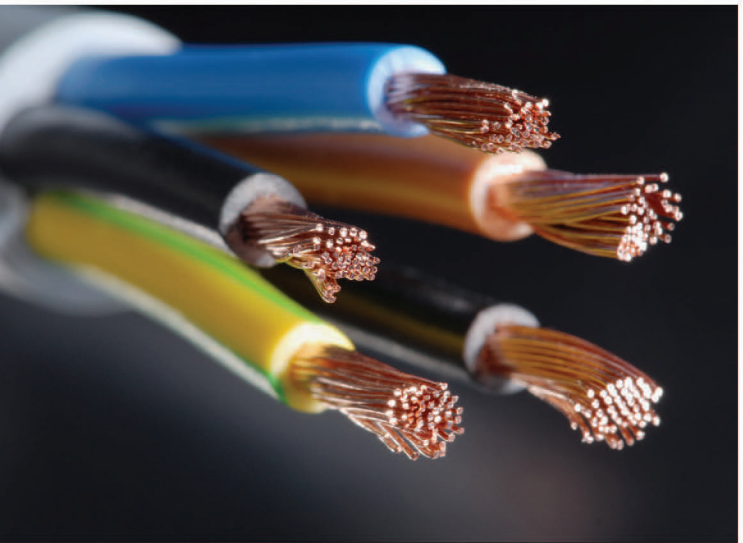

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3

WELDING AND CUTTING SAFETY

Key Words

acute symptoms
arc
chronic symptoms
duty cycle
earth ground
lockout
radiant energy
shade number
shielding gases
toxic fumes

Objectives

- Discuss electrical safety for arc welding.
- Explain welding safety principles.
- Choose protective clothing and equipment used for welding and cutting.
- Describe appropriate protection from arc rays.
- Discuss proper and improper handling of welding cables.
- Identify risks from exposure to welding fumes.
- Discuss safety requirements for oxyfuel cutting.
- Analyze basic safety rules of oxyfuel cylinders and gases.

When welding and cutting, safety must be a primary concern of everyone in the agricultural mechanics shop. Hazards such as burns or eye injuries can be reduced by taking precautions and following safety guidelines. Attention to detail and a safe working environment with the proper equipment can minimize the risks of accidents. In addition to ensuring a safe work environment, it is important to always wear the proper protective clothing and equipment. By taking the time to ensure a safe environment, accidents and injuries can be reduced.

Electrical Safety for Arc Welding

Electrical safety is an important consideration when welding. All electrical equipment should be properly grounded for safety reasons, and this ground should not be confused with the work lead to work piece ground that completes the welding circuit. An ***earth ground*** refers to the connecting of electrical equipment to the earth by a wire or some other conductor. When working in high places, carefully examine the work area for electrical hazards because a shock in such conditions could cause a fall and severe injury.

Arc welder worker in protective mask
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Equipment used must be adequate for the job and should be installed so that it meets any necessary codes, such as building and electrical codes. If any equipment part becomes damaged, it should be repaired or replaced before using the equipment. When equipment is not being used, it should be turned OFF. All electric power sources must be disconnected and locked out before any work is completed on electrical equipment. To ***lockout*** equipment is to use a device that makes the equipment inoperable while being worked on. Live electrical parts should never be touched, and a person should always ensure that he or she is insulated from the live electrical parts. Also, the ground must be kept as far away from the arc as possible. The ***arc*** is the bright light created between the electrode and base metal when welding.

Proper personal protective equipment (PPE) in good condition should be worn when welding. For example, gloves should not have any holes. Keep work area, equipment, and clothing dry because even a slight amount of moisture can conduct enough electricity to cause a severe shock.

Electrical connections should be kept tight, clean, and dry because poor connections can heat up, cause bad welds, produce dangerous arcs and sparking, and even melt. Do not use cables that are in poor condition or wrong for the job. For example, never use cables that are too small or show signs of damage. Cables should never be wrapped or held around your body. Keep welding cables free of conduits, motors, and any other equipment that could cause a short circuit.

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Electrodes
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Safety precautions should always be followed when working with the electrode holders. An electrode holder should never be dipped in water to cool it. When working with welding machines set up for multiple operations, be very careful not to touch hot parts of the electrode holders—open-circuit voltages from two machines are increased and can cause a severe shock. The electrode should be removed from the electrode holder when work is finished.

The electric current that flows through a conductor causes localized electric and magnetic fields (commonly referred to as EMF). The process of welding creates electric and magnetic fields around welding equipment. These fields may interfere with medical equipment, such as pacemakers. Exposure to these fields can be minimized by taking safety precautions, including working away from the welding power source; routing the electrode and work cables together; and connecting the work cable to the workpiece as close to the area being welded as possible. In addition, a person should never coil the electrode lead around any part of the body or place his or her body between the electrode and work cables.

OSHA CASE STUDY

Employee #1 was a mechanical helper with a company that repairs heavy construction and hauling equipment. Employee #1 was working in the company's yard area, using an arc welder. He was welding steel traction bars, known as grouser bars, on the tracks of a front end loader. He had been welding for approximately four to five hours and then his coveralls caught fire, burning him. Employee #1 was wearing coveralls made of a 65/35 polyester/cotton blend fabric, instead of a protective leather apron that is normally worn for welding. He was hospitalized to treat the burns.

OSHA Accident Search: https://www.osha.gov/pls/imis/accidentsearch.accident_detail?id=202455267

Welding Safety Principles

Safety principles should always be followed when welding. A safe working environment with the proper equipment can reduce the risks of accidents and injuries. The greatest number of accidents in welding come from the machinery.

When welding, remember to always follow shop safety rules and manufacturer recommendations. Only use equipment after being properly trained. By following safety guidelines, the risk of accident and injury can be greatly reduced.

WELDING SAFETY GUIDELINES

Hazard	Risks	Guidelines
General hazards	Lack of awareness of surroundings and not following shop safety rules can lead to accidents.	▪ Wear appropriate personal protective clothing and equipment (PPE) ▪ Look out for other students and coworkers ▪ Never engage in horseplay ▪ Ensure work equipment and workpiece are properly set up and secured
Fire and explosion	Sparks from welding can cause fires and/or explosions.	▪ Wear proper PPE ▪ Have appropriate firefighting equipment ready for use and know how to operate it ▪ Never weld, cut or grind near flammable or explosive materials ▪ Never weld on any container that has held combustible materials ▪ Keep the area clear of flammable materials, use shielding as needed ▪ Have a fire watch in the work area
Electrical hazards	Electrically live parts of welding equipment can shock. Working in wet or damp conditions creates an electric shock hazard.	▪ Wear appropriate PPE, including dry gloves with no holes ▪ Ensure equipment is properly grounded ▪ Disconnect power to equipment before performing any service or troubleshooting ▪ Use dry insulation, such as a rubber mat or dry wood, to insulate the welder from the workpiece and ground ▪ Never touch electrically live parts or the electrode with bare skin or wet clothing ▪ Never permit an electrode holder to come in contact with a welding machine or gas cylinder ▪ Never arc weld or operate electrically powered equipment in wet or damp areas
Burns from arc rays	Arc rays can cause damage to both eyes and skin.	▪ Wear proper PPE, including eye and face protection ▪ Use the correct shade of filter lens ▪ Use non-flammable shielding to protect others in the work area
Respiratory hazards (fumes and gases)	Working in confined areas or lack of proper ventilation creates hazards. Certain electrode types, as well as paints and coating, may be hazardous.	▪ Ensure work area is properly ventilated; do not weld in areas where ventilation is inadequate ▪ Read and follow any cautions or warnings for electrode use ▪ Wear appropriate PPE and position head to minimize fumes
Housekeeping	Poor housekeeping, such as blocked pathways and work areas, creates tripping and falling hazards.	▪ Keep work area organized and clean ▪ Put equipment away in its proper location ▪ Check the welding area to make sure it is safe to work
Equipment	Equipment that is not used properly or is in need of repair creates hazards such as electrocution, burns, respiratory hazards, and other injuries. Gas cylinders present special hazards and must be treated carefully.	▪ Keep all equipment in good working condition; never use equipment that is in need of repair ▪ Follow manufacturer recommendations ▪ Respect gas cylinders as dangerous and potentially lethal ▪ Never use oil on gas cylinders, regulators, connections or hoses ▪ Never cut or weld directly on concrete ▪ Keep cylinders upright and properly secured ▪ Never attempt to lift a machine with a cylinder attached to it

Shielding Gas Safety Guidelines

Shielding gases are non-flammable, non-reactive gases forced out of a welding gun or released from the flux of an electrode to protect the arc area. Skin should not be exposed to carbon dioxide or nitrogen because these gases are cold enough to cause frostbite.

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Some non-flammable shielding gases such as argon, nitrogen, carbon dioxide and helium should be stored in a well-ventilated area. Gases such as nitrogen, argon, helium, and carbon dioxide are considered simple asphyxiates. These gases can displace oxygen, which can be dangerous if stored in an enclosed area.

Duty Cycle Safety Guidelines

A ***duty cycle*** is the length of time within a 10-minute period that a welding machine can be safely operated to avoid overheating. For example, if a machine has a 20% duty cycle, it can be safely operated 2 minutes out of each 10-minute period.

Since the duty cycle is rated at the maximum output of a welding machine, the lower the percentage, the more attention is required to time spent actually welding. Not following the performance reference of the duty cycle can ruin a welding machine. The National Electrical Manufacturers Association (NEMA) established a classification system as a guideline to safe operation of welding machines.

Class I — rated to deliver output at duty cycles of 60, 80 or 100%
Class II — rated to deliver output at duty cycles of 30, 40 or 50%
Class III — rated to deliver output at duty cycles of 20%

Electrode Wire Safety Guidelines

Just as in working with any other material or equipment in the shop, safety glasses should always be worn when working with electrode wire. Loose ends can spring up and injure an eye.

A worker should ensure the correct spool or coil is used before loading and cutting tie wires. Hold the free end of the electrode wire firmly with dry, gloved hands to avoid backlash during the reloading procedure – failure to do so could ruin an entire spool or coil. Position coils close to the reel before lifting, and lift with your legs instead of your back. A standard coil weighs between 50 and 60 pounds.

A wire gun should never be pointed at anyone nor looked into while feeding wire through it. A person should also never place his or her finger or hand over the contact tip to check if the wire is feeding properly.

Protective Clothing and Equipment

Protective clothing and personal protective equipment (PPE) are mandatory in the welding shop to reduce exposure to hazards, such as molten slag and metal, which can be thrown off or fall from the welding arc. Wearing the proper protective clothing and equipment can help prevent injuries. The specific type of PPE worn will vary depending upon the type of welding or cutting being performed.

Basic clothing requirements include a heavy, long-sleeved shirt made of cotton with pocket flaps and heavy, cuff-less pants with no fraying at the bottom. Clothes made of synthetic materials such as polyester or rayon should not be worn because these fabrics melt when heated and can easily catch fire. Heavy leather boots with uppers that reach above the ankle help prevent burns from sparks and splatter. Steel-toed boots are not required but are highly recommended as the best choice.

Appropriate safety glasses should always be worn to guard against shop hazards, such as flying metal, and welding fumes. For example, clear safety glasses can be worn under a welding helmet, and glasses without vents are worn around chemicals.

A welding helmet with a correctly shaded lens to protect from sparks and arc rays must be worn when welding. A welder's cap with flexible bill can be slipped around to cover an ear to keep sparks and metal splatter from entering the ear opening. Welding caps are worn under welding helmets.

Leather gloves with gauntlets
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Heavy leather gloves with gauntlets, or coverings for the forearms, are used for welding and cutting activities. Leather jackets or aprons are worn for additional protection when welding out of position or in confined areas where flying sparks present an increased hazard.

To provide good visibility when chipping or grinding, wear a clear, plastic-type face shield because it will provide protection from slag or metal. A face shield should not be substituted for safety glasses because safety glasses should be worn at all times in the welding workplace.

A hard hat is necessary in situations where the danger of falling materials or tools may be present. Contractors sometimes require a hard hat in certain job situations.

Ear protection is worn to protect against noise levels. Types of ear protection include earmuffs and ear plugs. Continued exposure to loud noises can result in hearing loss. The Occupational Safety and Health Administration's permissible exposure limit for noise levels is 90 decibels for an 8-hour workday. However, a limit of 85 decibels is recommended by the National Institute for Occupational Safety and Health (NIOSH).

Respiratory protection, such as masks and respirators, is used to protect against toxic fumes and gases. ***Toxic fumes*** are gases that are poisonous and capable of causing injury or death. Simple face masks can be used to filter out dust, while a respirator is required to protect against toxic fumes or gases. For example, welding on galvanized metal creates fumes and precautions should be taken.

Appropriate Protection from Arc Rays

Electromagnetic energy that is given off by an arc or flame when welding can cause injury, especially to the eyes. This energy is referred to as ***radiant energy*** or light radiation. Personal protective equipment such as safety glasses or goggles, welding helmets and welding face shields are used to protect eyes from the arc ray. Requirements for eye protection are outlined by the Occupational Safety and Health Administration (OSHA). Eye and face protection should comply with ANSI Z87.1 *American National Standards Institute Practice for Occupational and Educational Eye and Face Protection*.

The equipment used must have the appropriate filter lenses of the correct shade. A welding helmet with the appropriate lens shade will protect the eyes from damaging light rays. The ***shade number*** indicates how much light is allowed through the filter lens. A higher shade number indicates that less light will pass through the lens. Darker filter lenses will have higher shade numbers.

There are different types of welding helmets available. Some welding helmets have a stationary filter lens. This type has a fixed lens housing where the shaded lens is held in by a spring retainer. The lens can be slipped out and replaced as welding requires.

Helmet with flip-up filter lens
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The welding helmet with flip-front filter lens has a housing with a front side that can be flipped up so that it leaves a clear-glass lens that permits the hood to be worn while chipping and cleaning welds.

Welding helmets that have an auto-darkening lens are also available. This type of welding helmet has a lens that automatically darkens when sensors detect an arc. Batteries are typically used to power the lens and should be tested before each use to determine if viable. If batteries are low or dead, the lens may not darken as it should.

Welding mask with light-sensitive element
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A helmet with the appropriate shade of filter lens must always be worn when welding. If not welding, other appropriate eye and face protection can be used.

When determining the appropriate lens shade for shielded metal arc welding, the electrode size and arc current (amperes) are taken into account. The electrode size and amperage range for the electrode dictate the lens protection required. One should select a lens shade according to the lens manufacturer's selection chart but never select less than a #8 lens shade for shielded metal arc welding. For shielded metal arc welding, the lens should be a #10 shade or higher. The table shows suggested lens numbers; shade numbers should always be selected to meet specific needs for the task being done.

Operation	Electrode Size – inch (mm)	Arc Current (Amperes)	Minimum Protective Shade Number	Suggested Shade Number
Shielded Metal Arc Welding (SMAW)	Less than 3/32 (2.4)	Fewer than 60	7	--
	3/32-5/32 (2.4-4.0)	60-160	8	10
	5/32-1/4 (4.0-6.4)	160-250	10	12
	More than 1/4 (6.4)	250-550	11	14

Handling Welding Cables

Welding cables must be properly taken care of so they do not become a safety hazard. A cable's covering acts as insulation for the conductors and prevents shock or electrical shorts. Protect cables from sharp objects that may damage their covering, and never drag welding cables through oil or force them over an obstruction by pulling. Cables that are frayed or exposed can cause serious injury due to electrocution hazards. In addition, if two exposed cables are crossed, it can cause them to arc, creating electrocution hazards.

Use only clean, dry rags to clean welding cables, never oily rags. In the case of holes in the protective covering, water or dirt from an infected rag could penetrate the cable.

A welding cable should never drape over any type of gas cylinder. Cables should be stored on a flat surface off the floor when not in use. Kinks in cables can cause holes in the protective covering.

CAREER SPOTLIGHT

Product Safety Engineer

Product safety engineers play an important role in ensuring the safety of products. They help ensure the safety of the products we use, and develop and conduct tests to evaluate the safety level of products. Product safety engineers also make recommendations on the best way to reduce or eliminate hazards.

Product safety engineers may perform many different tasks in their career such as investigating causes of accidents, injuries, or illnesses that may be connected with product usage. Product safety engineers may help develop solutions to reduce the risk of recurrence. They may also evaluate potential health hazards or damage that could be caused by misuse of products. Product safety engineers may help in the preparation of label instructions such as product usage or precautionary statements. They may also recommended procedures to minimize product hazards, report accident investigations, and conduct research to determine safety levels for various products.

Safety engineers must know how to use tools such as shock testing apparatus, instrument transformers, torsion testers, calipri meters, and voltage or current meters. They must also know how to use software related to their job such as computer aided design (CAD) software and spreadsheet software. Product safety engineers must be knowledgeable in a variety of areas such as engineering and technology, design, English language, law and government, mathematics, physics, mechanical, public safety and security, and chemistry.

Product safety engineers must also have a variety of skills and abilities to perform effectively in their positions. They must be able to communicate effectively and be skilled in writing, speaking, and listening. They must be able to effectively comprehend written materials. Other skills required include critical thinking, reading comprehension, complex problem solving, operations analysis, and active learning. Product safety engineers must be able to make decisions and judgments so the best choices are made. They must be proficient in both inductive reasoning and deductive reasoning. Product safety engineers must have problem sensitivity, which is the ability to determine when something is wrong or likely to go wrong. They must also have information ordering abilities, which is the ability to arrange items or actions in order.

Product safety engineers should be able to pay attention to detail, analyze information, take initiative, be persistent, accept criticism, and work with others.

In order to become a product safety engineer most employers require a bachelor's degree with work-related skill, on-the-job experience, career and technical training, knowledge, or experience. The median wage for product safety engineers is $ $37.89 hourly, $78,820 annual.

Sources
O*Net OnLine
Summary Report for: 17-2111.03 - Product Safety Engineers
http://www.onetonline.org/link/summary/17-2111.03

Welding Fumes

Hazardous fumes can come from many sources. Welding produces metal fumes and gases that can make a person ill, and in some cases, toxic fumes can kill. Welding fumes can occur from the metals, and from shielding and process gases. Whether a person is welding as a career or welding as a student in an agricultural mechanics shop, he or she needs to be aware of the hazards of welding fumes and avoid them. Before welding, it is important to know the type of metal being welded. For example, galvanized metal puts off very toxic chemicals in the process of welding, so the area needs to be very well ventilated. All gases, fumes, and vapors that come from metal, paints, fluxes, degreasers, and rods during welding are covered by the OSHA Hazard Communication Standard that states an employer must train employees about the risks.

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Exposure to welding fumes and gases can result in both acute and chronic symptoms. ***Acute symptoms*** are those effects that are apparent shortly after exposure, while ***chronic symptoms*** may not be apparent until later, sometimes even years after exposure. Health problems vary greatly but can include issues such as respiratory problems, kidney damage, weight loss, chemical pneumonia, diarrhea, fatigue, pulmonary edema, and skin irritation. Acute symptoms that may arise from exposure to welding fumes and gases include nausea, dizziness and irritation of the eyes, nose, or throat. Prolonged, or chronic exposure, may cause lung damage, cancer and other health problems. In addition, gases such as helium, argon and carbon dioxide displace oxygen and can potentially cause suffocation. Suffocation hazards are greatest in confined or enclosed spaces.

Metals such as steel, nickel, chromium, manganese, beryllium, cadmium, cobalt, copper, iron, lead, zinc, as well as other metals, can contain toxic properties. Zinc is used in the manufacturing of various alloys and can cause a flu-like illness called metal fume fever. Cadmium is used as a rust-preventive coating on steel and is also used as an alloying element. Long-term exposure can cause emphysema and kidney damage. Metals that have been painted with lead-based paint can cause lead poisoning.

Shielding gases such as argon, helium, nitrogen, and carbon dioxide pose a risk. Process gases produced during welding such as nitric oxide, nitrogen dioxide, carbon monoxide, ozone, phosgene, hydrogen fluoride, and carbon dioxide also present risks. The deadly gas, carbon monoxide, can form in oxyacetylene welding. Welding methods and the welding arc can form ozone and nitrogen oxide. These gases and solvents can cause irritation and lung damage. MIG and TIG welding make the most ozone, especially when aluminum is welded. These fumes irritate the eyes, ear, nose, throat, and lungs, and can damage the lungs. Some nitrogen oxides can cause fluid in the lungs.

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There are several factors that affect welding fume exposure including the type of welding process; the base metal and filler metals; composition of the welding rod; welding area; and ventilation practices. In addition, the safety and work practices of the individual affect exposure to welding fumes. Exposure can be minimized by following safety guidelines.

Welding fumes are strong in enclosed spaces. The local-exhaust ventilation should be used to remove fumes and gases at their source in still air. If welding outdoors, air blowers can be used to blow fumes away. The exhaust hood opening should be kept 4 to 6 inches from the fume source even when not in a confined space. A respirator can be used when unsure if there is good ventilation. If respirators are used, a full respiratory protection program must be in place.

The safest welding method should always be used for the job. Some welding processes such as shielded metal arc welding (stick welding) release less fumes than flux core welding. Low fume welding rods can be used since 90% of welding fumes can come from the rod.

Oxyfuel Cutting Safety Requirements

When cutting metal using an oxyfuel set up, safety rules and guidelines must be followed. Hazards such as fires or explosions can occur around oxyfuel equipment. Precautions will minimize risks of injury to people and damage to equipment.

The risks of any type of fire or explosion can be minimized by taking the appropriate precautions. Shielding screens should be used to protect nearby areas because higher oxygen pressure creates showering sparks. In addition, because cutting sparks can fly long distances, flammable materials should be moved a safe distance from the cutting area.

A cutting torch operator should never weld or cut into any container that has held flammable materials because it may still contain the residue of highly explosive materials. In order to control fire from entering back into the cutting torch, the oxygen and fuel lines should have reverse flow-check valves and flash arrestors. Connections should be checked for leaking gases to prevent fires or explosions.

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The work area should be kept free of grease, oil, and flammable materials because sparks can fly several feet and cause a fire. In addition, oil should never be used on cutting equipment because oil and grease may ignite spontaneously when in contact with oxygen. Cutting should be performed on a proper cutting table that provides a work area with a grated surface that permits slag to drop through into a slag box. It is important to never leave torches, tips, or hot metal where they can be accidentally touched by another student, worker or visitor.

Unlike in welding where the electrode holder should not be dipped in water, hot metal should be cooled or quenched and sparks extinguished before leaving the work area. In addition, ensure that cylinder valves are closed and pressure is relieved from the hoses before leaving the work area.

Proper personal protective clothing and equipment should always be worn when oxyfuel cutting. Leather gloves with gauntlets, leather apron, welding chaps, welding cap, safety glasses and leather shoes help prevent burns and injury. For oxyfuel cutting, goggles or a face shield with a minimum of a No. 5 filter lens should be worn. Some hair sprays are highly flammable and can be ignited by sparks, and any kind of plastic hair cap or covering is dangerous in the welding area.

Oxyfuel Cylinders and Gases Safety

Oxyfuel welding and cutting uses two cylinders, one that contains oxygen and another that contains gas (fuel). Cylinders should always be kept in an upright position securely fastened to a wall or cart. If there is a possibility for cylinders to be struck or to sustain other physical damage, move them to a more secure location. When regulators are not attached to the cylinders, place safety caps over the connections to prevent damage to valves.

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Transporting cylinders must be done carefully with precautions taken to ensure safe transport. When transferring cylinders, the protective caps must be in place with the regulators removed.

Manufacturer recommendations and safety precautions for cylinders are established for the protection of the user. Each type of gas cylinder has operating pressures for the specific task being performed, and these pressures are provided in the recommendations. It is not safe to use oil on regulators, torches, fittings or any other equipment that may come into contact with oxygen because heat, flames and sparks could result.

Cylinder valves must also be opened slowly, and the operator should stand on the side opposite the regulator when opening the cylinder valve. Valves are typically only opened as much as needed, approximately 1/2 turn and no more than 3/4 turn, which will allow the cylinder to be closed quickly if a fire occurs. The valve on the oxygen tank should be opened fully.

Before beginning a cutting task, cylinders and hoses should be inspected for signs of damage. A leak check can be accomplished by pressurizing the hoses and watching the gauges for a drop in pressure, indicating a leak. When checking for leaks, use manufacturer approved liquid leak check solutions.

Before attaching regulators, cylinders should be secured in a vertical position. Valves are cleared by removing the protective caps and slowly opening the valve a quarter turn and then closing it. Dirt is then wiped from the inside of the valve nozzle. It is important to remember to stand with the valve outlet nozzle pointed away from the body to avoid an accident, such as the valve blowing unwanted particles into the face.

When attaching the hoses, connect the red hose to the gas regulator. The green or black hose is attached to the oxygen regulator. The oxygen and fuel gas lines must be purged before lighting the torch. Each hose should be purged individually by opening the valves for several seconds. Always light the gas before opening the oxygen valve on the torch.

Oxyfuel metal cutting
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Unit Summary

Safety is an overriding consideration when welding and cutting. One mistake or inattention to detail could result in an accident and injuries. Electrical equipment used for arc welding must be properly grounded and meet all applicable codes. Following welding safety principles will minimize the risk of accidents and injuries. A significant part of welding safety is always protecting the eyes from arc rays. Personal protective equipment, such as safety glasses or goggles, welding helmets and face shields, should be worn to prevent eye and face injury.

It is very important to follow safety requirements when oxyfuel cutting because hazards such as fires or explosions can occur. Protective clothing and personal protective equipment (PPE) are mandatory in the welding shop to reduce exposure to hazards. The appropriate clothing and protective equipment will reduce the risk of injury. Welding helmets, welding caps, gloves, safety glasses, face shields, and proper clothing are essential. Ear protection and respiratory protection may also be required for safety reasons. Safety in the use of oxyfuel cylinders is important and cylinders must be properly secured and stored. Safety hazards can also be minimized by properly handling welding cables and taking adequate measures to prevent exposure to welding fumes.

Unit Review

1. What should be done with any electrical equipment before it is worked on?
2. What are some electrical safety guidelines to follow regarding cables and electrode holders?
3. What are some guidelines to minimize fire and explosion hazards when welding?
4. What are some guidelines to minimize respiratory hazards when welding?
5. Why should skin not be exposed to shielding gases such as carbon dioxide or nitrogen?
6. What can occur if the duty cycle is not followed?
7. List basic protective clothing requirements for welding.
8. What does the shade number indicate?
9. What are the different types of welding helmets available?
10. What are some actions that should be taken to protect welding cables?
11. Explain where welding fumes come from during the welding process.
12. What are some acute symptoms and chronic symptoms of exposure to welding fumes?
13. What are some precautions to minimize the risk of fire or explosion when oxyfuel cutting?
14. How should oxyfuel cylinders be stored?
15. How can the appropriate gas cylinder operating pressure be determined?