

Course	Agricultural Science II
Unit	Agricultural Mechanics II
Subunit	Oxyacetylene Welding
Lesson	Welding With Oxyacetylene
Estimated Time	Five 50-minute blocks
Student Outcome	

Weld with and without filler rods using an oxyacetylene outfit.

Learning Objectives

1. Describe the differences between the oxyacetylene welding outfit and the cutting outfit.
2. Explain when the welding rod is used for oxyacetylene welding.
3. Identify some characteristics of welding rods used for oxyacetylene welding.
4. List some factors that influence the quality of the weld.
5. Identify common problems to avoid when welding with oxyacetylene.

Grade Level Expectations

SC/ME/1/G/09-11/a

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slides
 - ☐ PPt 1 – Welding Torch
 - ☐ PPt 2 – Angles for Welding
 - ☐ PPt 3 – Torch Movement Patterns
2. Activity Sheets
 - ☐ AS 1 – Running a Continuous Weld Pool With and Without Welding Rod (Instructor)
 - ☐ AS 1 – Running a Continuous Weld Pool With and Without Welding Rod (Student)
 - ☐ AS 2 – Welding a Butt Joint in Flat Position Using Welding Rod (Instructor)
 - ☐ AS 2 – Welding a Butt Joint in Flat Position Using Welding Rod (Student)
 - ☐ AS 3 – Welding an Edge Weld in a Flanged Butt Joint Without Welding Rod (Instructor)
 - ☐ AS 3 – Welding an Edge Weld in a Flanged Butt Joint Without Welding Rod (Student)
 - ☐ AS 4 – Welding an Outside Corner Joint With and Without Welding Rod (Instructor)
 - ☐ AS 4 – Welding an Outside Corner Joint With and Without Welding Rod (Student)
3. *Agricultural Mechanics Unit for Agricultural Science II* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 2002.
4. *Curriculum Enhancement for Agricultural Mechanics Unit for Agricultural Science II, "Unit III – Oxyacetylene Welding."* University of Missouri-Columbia: Instructional Materials Laboratory, 2004.

Supplies & Equipment

- ❑ See AS 1 through AS 4 for materials and equipment needed to complete the Activity Sheets.

Supplemental Information

1. Print

- ❑ Althouse, A., C. Turnquist, W. Bowditch, and K. Bowditch. *Modern Welding*. Tinley Park, IL: Goodheart-Willcox, 2000.
- ❑ Jeffus, L. *Welding Principles and Applications*. 5th ed. Clifton Park, NY: Thomson-Delmar Learning, 2004.
- ❑ Phipps, L., and G. Miller. *Introduction to Agricultural Mechanics*. Upper Saddle River, NJ: Prentice Hall Interstate, 2004.

2. Electronic Media

- ❑ Smartflix offers a line of videos related to metalworking that can be rented from their Web site. Accessed September 12, 2007, from <http://smartflix.com/store/category/115/Metalworking>.
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Interest Approach

Students should be familiar with much of the oxyacetylene outfit from *Agricultural Mechanics Unit for Agricultural Science I*, Unit VI Lesson 2. Have students identify parts of the outfit and review the setup, use, and shutdown procedures they should use for the equipment.





Communicate the Learning Objectives





1. Describe the differences between the oxyacetylene welding outfit and the cutting outfit.
2. Explain when the welding rod is used for oxyacetylene welding.
3. Identify some characteristics of welding rods used for oxyacetylene welding.
4. List some factors that influence the quality of the weld.
5. Identify common problems to avoid when welding with oxyacetylene.

Instructor Directions	Content Outline
<p>Objective 1</p> <p><i>Students should be familiar with oxyfuel cutting, which was covered in Agricultural Mechanics Unit for Agricultural Science I. Introduce oxyacetylene welding by discussing differences between the welding and cutting outfit. Refer to PPt 1.</i></p> <p>☐ PPt 1 – Welding Torch</p>	<p>Describe the differences between the oxyacetylene welding outfit and the cutting outfit.</p> <p>Torch design – The welding torch does not use an additional oxygen line to produce a cutting jet of oxygen.</p> <p>Regulators</p> <ol style="list-style-type: none">1. The oxygen regulator used for the cutting outfit may be designed to work under greater pressure because of the volume of oxygen that can be used when cutting thicker pieces of metal. If different oxygen regulators are used in the shop for different applications, check with the instructor to be sure the regulator is designed for the work that is being done.2. The same acetylene regulator used for cutting can be used for welding because the working pressure of acetylene should always be below 15 psi to avoid risk of fire and explosion.
<p>Objective 2</p> <p><i>Oxyacetylene welding can be done with and without filler rods. Discuss reasons why filler rod would be used. Examples of welding rods can be given to students to examine. These filler rods can be compared to examples of electrodes used in shielded metal arc welding.</i></p>	<p>Explain when the welding rod is used for oxyacetylene welding.</p> <p>For some oxyacetylene procedures, a welding rod is needed to add metal and strengthen the weld.</p> <p>Other oxyacetylene welds can be made by welding one piece directly to another.</p>

Instructor Directions	Content Outline
<p>Objective 3</p>	<p>Identify some characteristics of welding rods used for oxyacetylene welding.</p> <p>Welding rods are metal rods similar to the material they will be used to weld.</p> <p>They are generally 36 in. long and are available in different diameters, from 1/16 to 3/8 in.</p> <p>Like arc welding electrodes, welding rods used for oxyacetylene welding are available in different tensile strengths.</p> <ol style="list-style-type: none"> 1. Tensile strength is indicated in the AWS classification number. 2. For an RG-45 rod, the "R" indicates it is a welding rod, the "G" indicates it is used for gas welding, and "45" indicates it has a tensile strength of approximately 45,000 psi. <p>Welding rods are designed to produce safe, strong welds when used in the procedures and for the conditions specified by their classification number. Substituting other types of wire for welding rod is not acceptable for the following reasons.</p> <ol style="list-style-type: none"> 1. The composition of another type of wire can vary greatly. 2. It can produce porous, substandard welds. 3. It can include finishes or coatings that produce toxic fumes.
<p>Objective 4</p> <p><i>The size of the torch tip and welding rod and the position of the torch are key elements in creating strong welds with the oxyacetylene outfit. Supplement with more detailed procedural information as needed. Refer to PPTs 2 and 3.</i></p> <p> PPT 2 – Angles for Welding</p>	<p>List some factors that influence the quality of the weld.</p> <p>Torch tip size</p> <ol style="list-style-type: none"> 1. The right tip must be chosen for the job because tip size is a factor that controls the width of the weld bead, the penetration of the weld, and the speed of movement. 2. Torch tips are designed to work within a specific operating range. Do not adjust the torch flame to compensate for the wrong tip size. Use the correct tip instead.

Instructor Directions	Content Outline
<p>☐ PPt 3 – Torch Movement Patterns</p>	<p>Torch position</p> <ol style="list-style-type: none"> 1. Torch position has a great effect on the speed of melting and the weld pool. Two key aspects of torch position are angle and distance from work. 2. Torch angle <ol style="list-style-type: none"> a. The torch is held at an angle to the work. The closer the torch is held at a right angle to the work, the more heat is transferred to the base metal. b. A typical angle is 45 degrees. 3. Distance from work <ol style="list-style-type: none"> a. As the torch is moved closer to the work, the heating rate increases. b. A typical operating range is 1/8 to 1/4 in. from the work. <p>Torch movement</p> <ol style="list-style-type: none"> 1. As the torch is moved along the centerline of the weld, it is also moved back and forth or in a circular motion. <ol style="list-style-type: none"> a. The cone of the flame should stay in the weld pool during this motion. b. The flame should be advanced a distance of about 1/16 in. each time it is moved along the centerline. 2. There are two general techniques for directing flame at the weld pool. <ol style="list-style-type: none"> a. Forehand welding – The flame is pointed in the direction of travel and preheats the work ahead of the weld pool. b. Backhand welding – The flame is pointed in the opposite direction of travel and post heats the metal behind the pool, which helps to relieve welding stress. Backhand welding is generally used for welding cast iron and thicker metal. <p>Welding rod size</p> <ol style="list-style-type: none"> 1. A welding rod of the correct diameter must be selected because the rod can influence the width of the bead and the buildup and penetration of the weld. Below are some factors the welder should consider. <ol style="list-style-type: none"> a. A small-diameter welding rod can be used on

Instructor Directions	Content Outline
	<p>thick metal for better penetration, but rod that is too small will not add enough filler material.</p> <ul style="list-style-type: none"> b. A thicker welding rod can be used with thin metal to avoid burn through, but a rod that is too large can remove too much heat from the weld pool too quickly. This causes the pool to freeze and trap the rod. c. The correct size of welding rod will form a good bead and allow the weld pool to stay fluid as filler is added.
<p>Objective 5</p> <p><i>Discuss problems beginning welders can encounter using an oxyacetylene outfit. When students have reviewed and discussed oxyacetylene safety and procedures, AS 1-4 can be used to demonstrate the correct way to make basic welds using the oxyacetylene outfit. The student versions of these activities can be assigned to evaluate student competency.</i></p> <ul style="list-style-type: none">  AS 1 – Running a Continuous Weld Pool With and Without Welding Rod  AS 2 – Welding a Butt Joint in Flat Position Using Welding Rod  AS 3 – Welding an Edge Weld in a Flanged Butt Joint Without Welding Rod  AS 4 – Welding an Outside Corner Joint With and Without Welding Rod 	<p>Identify common problems to avoid when welding with oxyacetylene.</p> <p>Backfire – The flame goes out with a loud pop or snapping sound.</p> <ol style="list-style-type: none"> 1. Possible causes of backfire include the following. <ul style="list-style-type: none"> a. Overheating the tip – caused by overuse, getting too close to the work, or working in a hot corner b. Operating the torch at pressures that are too low for the tip being used c. Touching the tip to the work d. A loose or damaged tip e. Dirt in the tip 2. In case of a backfire, shut down the torch immediately and correct the cause before relighting the torch. <p>Flashback – The flame burns back inside the tip, torch, hose, or regulator, usually accompanied by a squealing or hissing sound.</p> <ol style="list-style-type: none"> 1. Possible causes of flashback include the following. <ul style="list-style-type: none"> a. Failure to purge the system prior to use b. Overheating the tip 2. If a flashback occurs, immediately close the torch oxygen valve and then the torch fuel valve. If fire is suspected in the hoses, close the acetylene valve, followed by the oxygen valve at the tank. The torch should be allowed to cool before the problem is investigated. 3. Flashback usually indicates a serious problem. An experienced operator must determine whether the outfit is safe to use or if parts must be repaired or replaced.

Instructor Directions	Content Outline
	<p>Improper flame adjustment for the procedure</p> <ol style="list-style-type: none"> 1. Carburizing (carbonizing) flame – low temperature; may add carbon to the cut or weld <ol style="list-style-type: none"> a. Excess acetylene present b. May be used for some brazing or welding procedures c. Causes the weld pool on steel to boil and be cloudy and produce brittle welds 2. Oxidizing flame – high temperature; may add oxygen to the cut or weld <ol style="list-style-type: none"> a. Excess oxygen present b. Inner cone is shortened and noisy c. Not recommended for most operations d. Forms oxides with many metals, which produces brittle, low-strength welds e. Causes foaming and sparking of the weld pool on steel and produces welds with low strength and ductility
<p>Application:</p> <ul style="list-style-type: none">  AS 1 – Running a Continuous Weld Pool With and Without Welding Rod  AS 2 – Welding a Butt Joint in Flat Position Using Welding Rod  AS 3 – Welding an Edge Weld in a Flanged Butt Joint Without Welding Rod  AS 4 – Welding an Outside Corner Joint With and Without Welding Rod 	<p>AS 1 – AS 4 Results will vary.</p>

Instructor Directions	Content Outline
Closure/Summary	<p>An oxyacetylene welding outfit is similar to a cutting outfit, except the welding torch does not use an additional oxygen line to produce a cutting jet of oxygen. Welding can be performed with or without filler rods, which when used add metal and strength to the weld. Most rods are similar to the material being welded, are generally 36 in. long, vary from 1/16 to 3/8 in. in diameter, and come in different tensile strengths. Among factors determining weld quality are torch tip size, torch position (angle and distance), torch movement, and welding rod size. Common problems to avoid when welding are backfire, flashback, and improper flame adjustment.</p>
Evaluation: Quiz	<p>Answers:</p> <ol style="list-style-type: none"> 1. d 2. c 3. a 4. a 5. a 6. d 7. b 8. <ol style="list-style-type: none"> a. The “R” indicates that it is a welding rod. b. The “G” indicates that it is used for gas welding. c. The “60” indicates that the filler metal has a tensile strength of 60,000 psi. 9. The student should list two of the following. <ol style="list-style-type: none"> a. The composition of other wire can vary greatly. b. Unclassified wire can produce poor-quality welds. c. Other wire can have coatings or finishes that produce toxic fumes. 10. <ol style="list-style-type: none"> a. Forehand welding – A welding technique in which the oxyacetylene flame is pointed in the direction of travel and preheats the work ahead of the weld pool. b. Back welding – A welding technique in which the oxyacetylene flame is pointed in the opposite direction of travel and post heats the metal behind the pool. 11. If a backfire occurs, the torch should be shut down immediately and all possible causes checked and eliminated before relighting the torch. 12. If a flashback occurs, the oxygen torch valve should be shut off immediately, followed by the acetylene

Instructor Directions	Content Outline
	<p>torch valve. If fire is suspected in the hoses, the acetylene cylinder valve should quickly be shut off followed by the oxygen cylinder valve. An experienced operator or technician should inspect the equipment to determine whether it is safe to use or which parts must be repaired or replaced.</p>