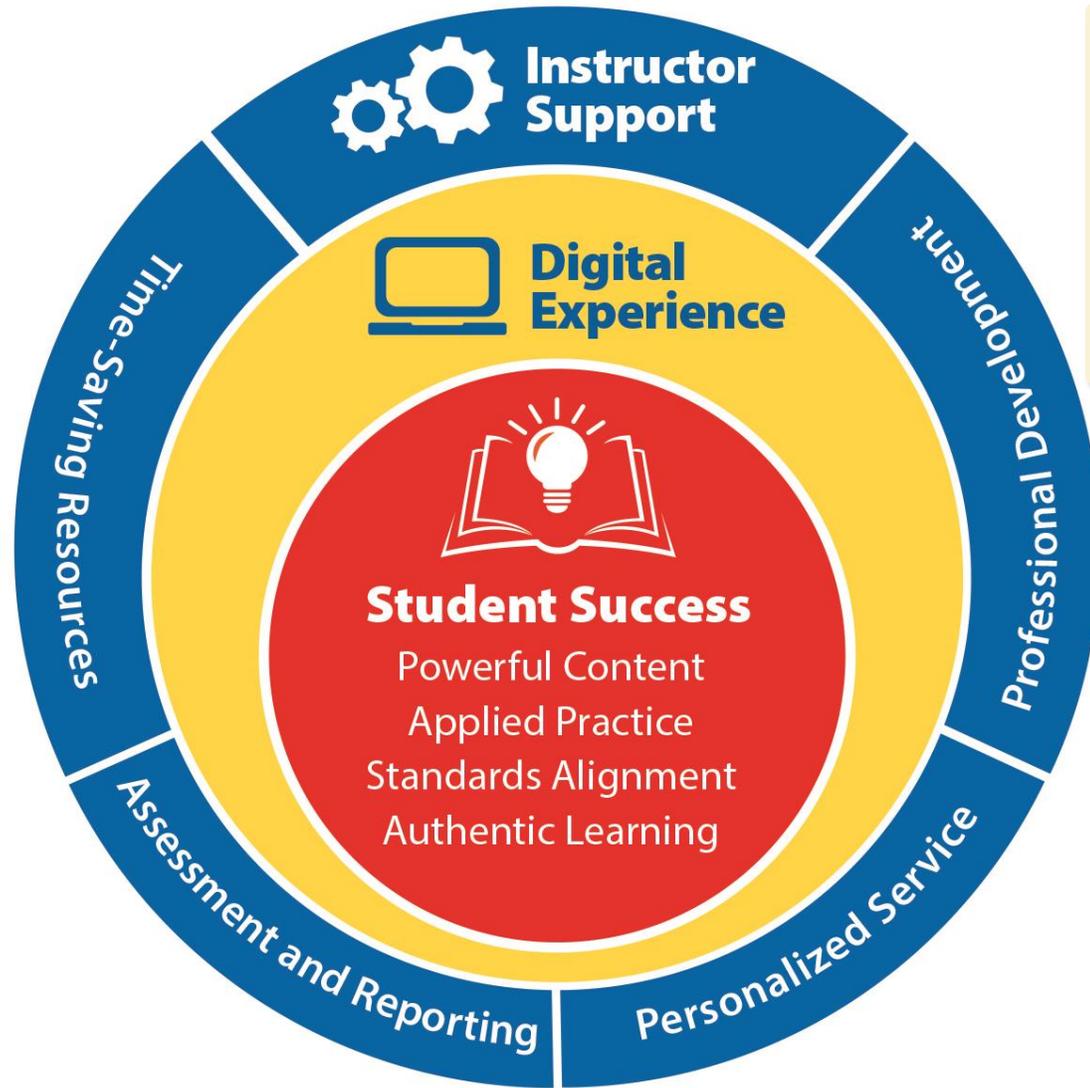


***Welding Fundamentals***



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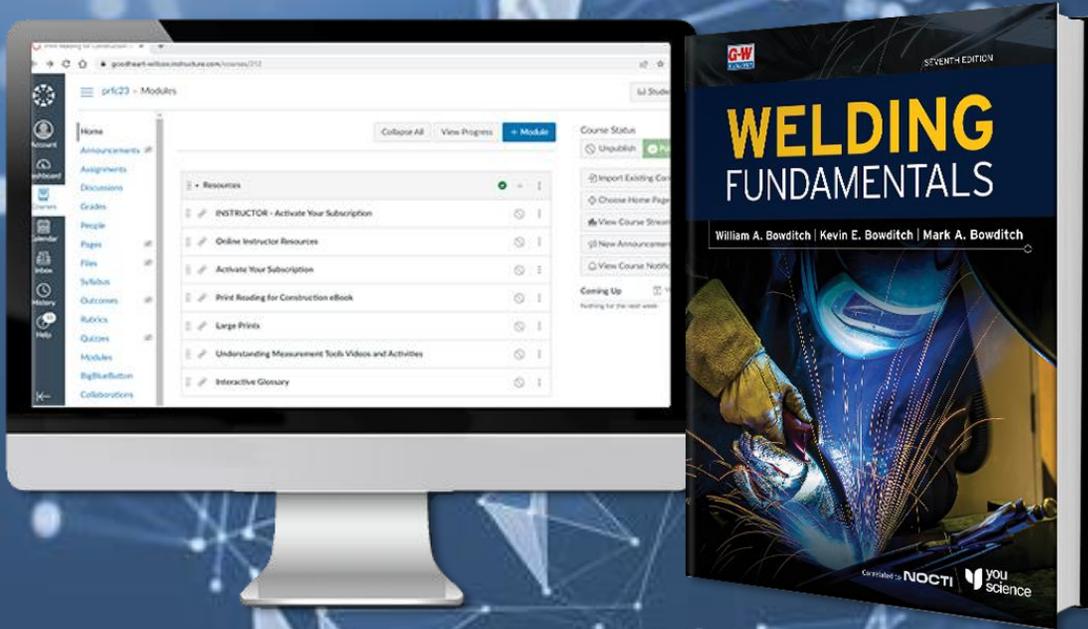


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# LMS and CMS Integration Easy Navigation

2: E-Flash Cards

Definition (1 of 31)

Item of value that is owned.

2: E-Flash Cards

Term (1 of 31)

asset

Select to flip

Previous Remove Next

## E-Flash Cards & Vocabulary Practice

### 2: Vocabulary Game

Select a point value. Choose the term that matches the definition.

Score: 800

<input checked="" type="radio"/> 100	100	100	100
200	200	200	200
300	<input checked="" type="radio"/> 300	300	300
400	400	400	<input checked="" type="radio"/> 400

**Definition:** Act of giving money, goods, or services to meet the needs of others and support causes that are important to an individual.

- pay yourself first
- variable expense
- recordkeeping
- philanthropy

Check Answer

## Interactive Activities

### Chapter 1: Careers in Welding

#### Chapter Review

**Objective:** You will be able to choose, prepare for, gain, and keep an appropriate job for yourself in the welding industry, whether you work as an employee or become an entrepreneur.

#### Instructions

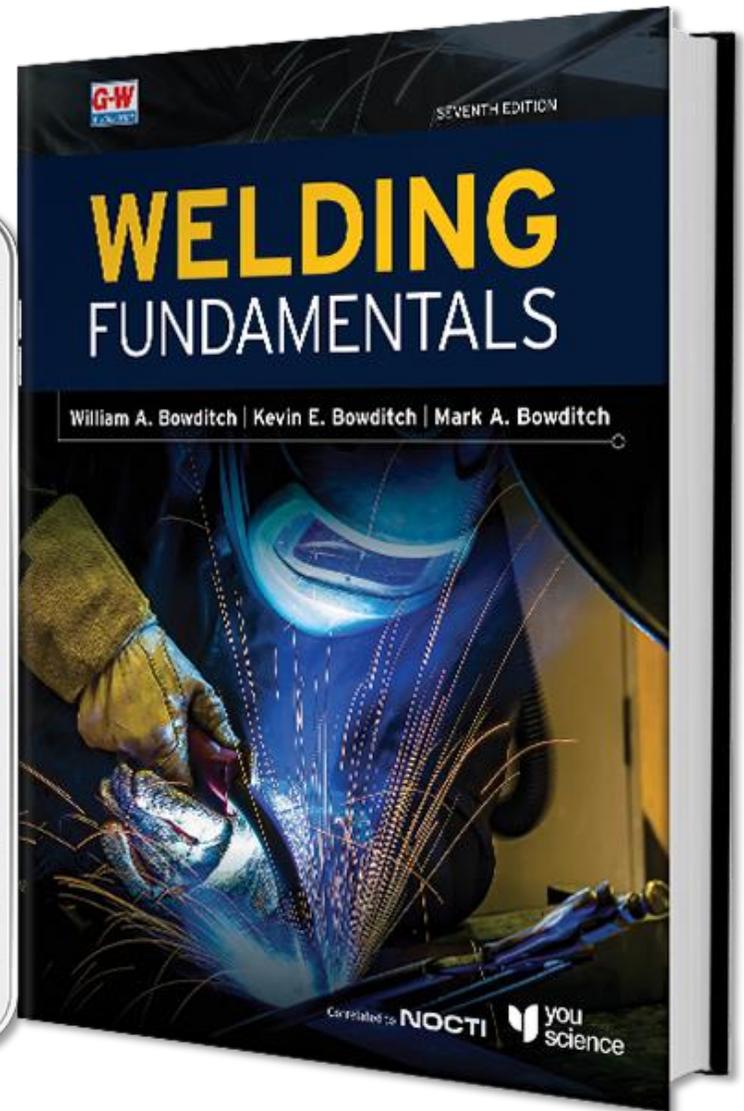
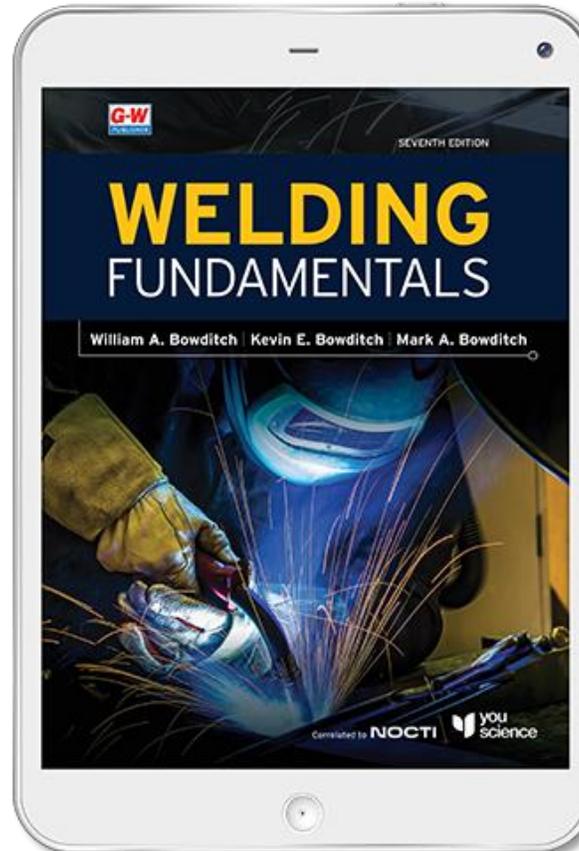
Carefully read Chapter 1 of the textbook and study the figures. Then, answer or complete the following questions.

- As you set your career goals, what three factors about yourself should you consider?  
Answer:
- The minimum level of education for a career as a welding inspector is \_\_\_\_\_ or \_\_\_\_\_.  
Answer:
- What is the minimum level of education for a person to be hired as a metallurgist?  
Answer:
- Which of the following school courses is *least* critical for success in the welding industry?
  - Geometry.
  - Computer-aided design (CAD).
  - Language arts.
  - History.
 Answer:

## Lab Workbook

# Integrate G-W Digital Resources

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PUBLISHER



©2026, 7th edition  
by William A. Bowditch, Kevin E. Bowditch,  
and Mark A. Bowditch

## BRIEF CONTENTS

### SECTION 1—INTRODUCTION TO WELDING

- 1 Careers in Welding
- 2 Safety in the Welding Shop
- 3 Welding and Cutting Processes
- 4 The Physics of Welding
- 5 Math for Welding
- 6 Math Applications for Welders
- 7 Weld Joints and Positions
- 8 Welding Symbols and Print Reading

### SECTION 2—SHIELDED METAL ARC WELDING

- 9 SMAW: Equipment and Supplies
- 10 SMAW: Equipment Assembly and Adjustment
- 11 SMAW: Electrodes
- 12 SMAW: Flat Welding Position
- 13 SMAW: Out-of-Position Welding

### SECTION 3—GAS METAL AND FLUX CORED ARC WELDING

- 14 GMAW and FCAW: Equipment and Supplies
- 15 GMAW and FCAW: Equipment Assembly and Adjustment
- 16 GMAW and FCAW: Flat Welding Position
- 17 GMAW and FCAW: Out-of-Position Welding

### SECTION 4—GAS TUNGSTEN ARC WELDING

- 18 GTAW: Equipment and Supplies
- 19 GTAW: Equipment Assembly and Adjustment
- 20 GTAW: Flat Welding Position
- 21 GTAW: Out-of-Position Welding

### SECTION 5—ARC CUTTING AND GOUGING

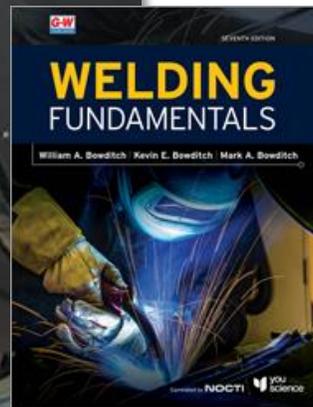
- 22 Plasma Arc Cutting and Gouging
- 23 Carbon Arc Cutting and Gouging

### SECTION 6—OXYFUEL GAS PROCESSES

- 24 Oxyfuel Gas Cutting and Welding: Equipment and Supplies
- 25 Oxyfuel Gas Cutting and Welding: Equipment Assembly and Adjustment
- 26 Oxyfuel Gas Cutting
- 27 Oxyfuel Gas Welding: Flat Welding Position
- 28 Oxyfuel Gas Welding: Out-of-Position Welding
- 29 Brazing and Braze Welding
- 30 Soldering

### SECTION 7—WELDING IN INDUSTRY

- 31 Pipe and Tube Welding
- 32 Robotics in Welding
- 33 Additional Welding and Cutting Processes
- 34 Inspecting and Testing Welds
- 35 Welder Certification



**Student Textbook**

## CHAPTER 23

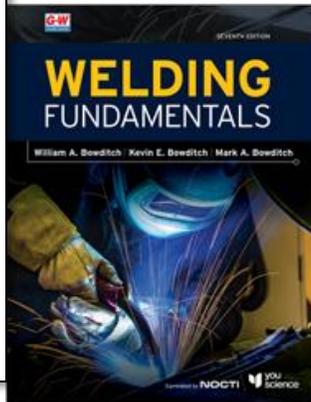
### Carbon Arc Cutting and Gouging



#### CHAPTER 23 LEARNING OUTCOMES

After studying this chapter, you will be able to:

- 23.1 Describe air carbon arc cutting (CAC-A) and gouging principles.
- 23.2 Identify and assemble the equipment and supplies used for air carbon arc cutting.
- 23.3 Recognize and implement necessary safety practices when using CAC-A equipment.
- 23.4 Perform cutting and gouging using CAC-A equipment.



#### EXERCISE 25-2

#### Lighting and Adjusting a Welding Torch

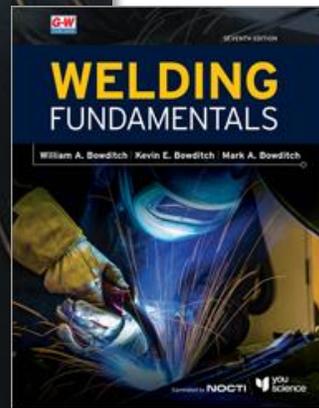
1. Open the acetylene torch valve approximately 1/16 turn, as shown in Figure 25-18.



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Figure 25-18. Open the acetylene torch valve.

# What's New to the Edition



## CHAPTER 5 LEARNING OUTCOMES

*After studying this chapter, you will be able to:*

- 5.1 Explain how the academic disciplines in STEM apply to welding.
- 5.2 Describe various applications for math in welding and in personal life.
- 5.3 Add, subtract, multiply, and divide whole numbers.
- 5.4 Add, subtract, multiply, and divide fractions.
- 5.5 Add, subtract, multiply, and divide decimals.
- 5.6 Perform conversions between fractions and decimals.
- 5.7 Use a calculator to perform simple calculations.

## CHAPTER 5 KEY TERMS

- addition
- common denominator
- decimal
- decimal point
- denominator
- difference
- division
- dot operator
- equivalent fractions
- fraction
- improper fraction
- mixed fraction
- multiplication
- numerator
- power of 10
- product
- reduce
- STEM
- subtraction
- sum
- whole number

# Chapter-Opening Materials

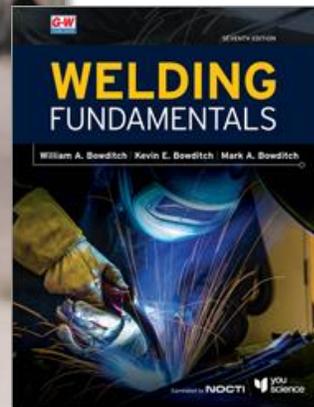


 **WARNING**

Keep fingers and hands clear of the end of the welding gun. The wire can pierce or puncture fingers and hands.

 **CAUTION**

If the flowmeter is open when the gas shut-off or cylinder valve is opened, the surge of high-pressure gas may damage the flowmeter.



## Special Features



 **NOTE**

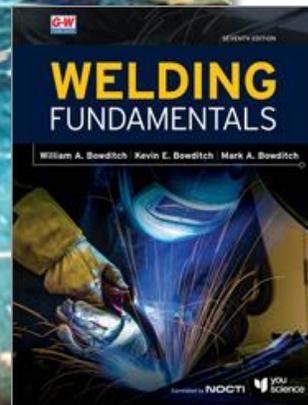
Switching the numbers in the numerator and the denominator of a fraction is referred to as inverting the fraction. The resulting fraction is referred to as the reciprocal of the original fraction.

Then, multiply the numerators and multiply the denominators. Just as with regular multiplication, you are able to reduce across numerators and denominators if they are both multiples of the same number. For example, 8 and 2 are both multiples of 2. Reduce them by dividing each by 2. Remember, the numerator and the denominator being reduced do not need to be from the same fraction.

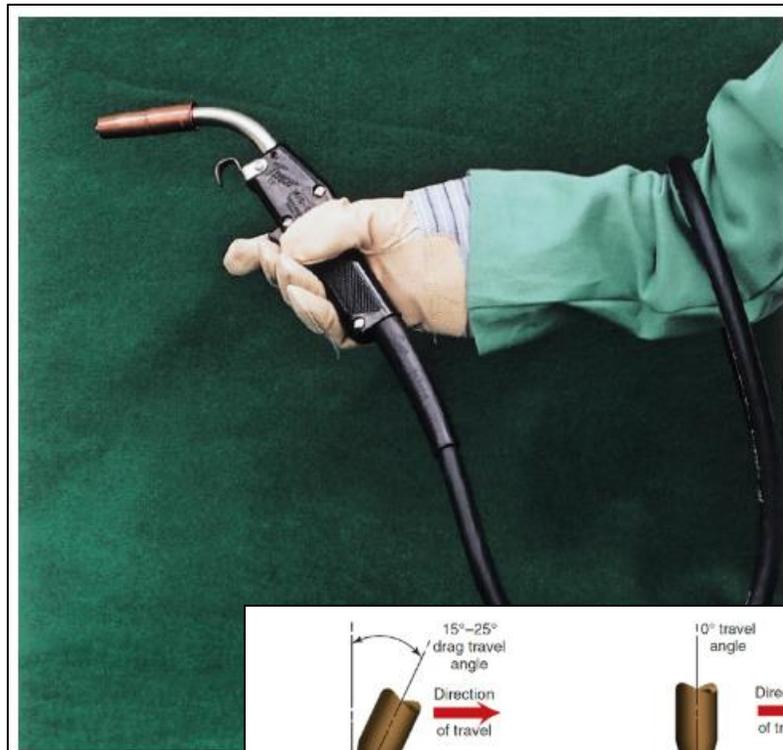
$$\frac{1}{2} \times \frac{8}{5} = \frac{4}{5}$$

 **NOTE**

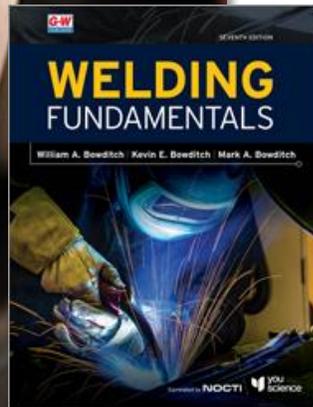
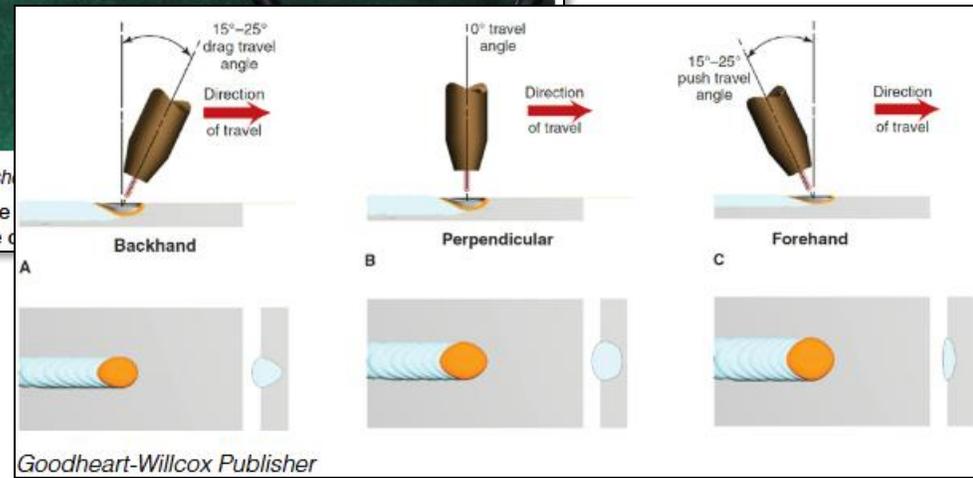
If a full equation is being simplified, the numerator and denominator being reduced must be on the same side of the equal sign.



## Special Features



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**Figure 16-5.** Looping the  
gun and makes it more c



# Illustrations and Photos



## Chapter 16 Summary

- 16.1** Preparing to weld requires the welder to know what type of base metal and thickness is to be used. Also, the welding position and type of metal transfer must be known. Based on this information, the proper electrode and diameter, drive rolls, contact tip, electrode extension, shielding gas type and flow rate, voltage, and wire feed speed can be determined, installed, or set.
- 16.2** Forehand welding (push) is used with GMAW on thinner metal. Backhand welding (drag) is used with GMAW on metal thicker than 1/8" (3.2 mm) and is used for all FCAW welding. Typical travel angle is 15°–25°. Watching the weld pool while welding and evaluating a complete weld bead are necessary skills.
- 16.3** Prior to welding various types of metal, the parts must be cleaned (if needed), aligned, measured, and tack welded. Welding fillet welds and butt welds requires proper set-up and welding techniques, such as maintaining consistent contact tip-to-work distance, electrode angles, and travel speed.
- 16.4** Preventing weld defects requires proper set-up and welding techniques as well as removing slag between weld passes.

## Chapter 16 Review Questions

Answer the following questions using the information provided in this chapter.

### Know and Understand

- Which of the following is *not* a factor a welder must consider before selecting an electrode and shielding gas? (16.1)
  - What type of base metal is to be welded.
  - What welding machine and wire feeder will be used.
  - How thick the base metal is.
  - What metal transfer method will be used.
- What flow rate is recommended to weld 1/16" stainless steel? (16.1)
  - 20 cfm.
  - 25 cfm.
  - 30 cfm.
  - 35 cfm.
- Which of the following is an appropriate voltage to weld carbon steel using a 0.035" electrode and short circuiting transfer? (16.1)
  - 15V.
  - 20V.
  - 25V.
  - 30V.

## STEM Connections

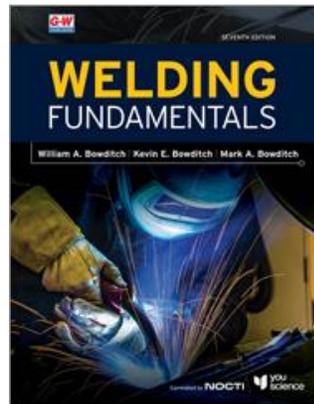
- 1. Engineering.** Conduct research to find out more about wire feeders commonly used to feed aluminum electrodes. Examine one or more wire feeder models, if possible. Then brainstorm ways to improve the equipment to reduce the number of bird nests that occur when soft wire is fed through the wire feeder. Write a proposal for the improvement you think would most likely succeed. (16.3)
- 2. Science.** Conduct research to find out more about aluminum oxide. Write a short report describing the differences in the chemical and mechanical properties of aluminum and aluminum oxide. Identify your sources. (16.3)
- 3. Technology.** Conduct research to find out what types of materials are used for backings for various types of metals. Create a table showing several base metals and the backing material used for each, as well as whether the backing becomes part of the completed joint. (16.3)

## Curricular Connections

- 1. Language Arts.** Write a short essay comparing the backhand welding methods. Identify the advantages and disadvantages of each method. (16.2)
- 2. Social Science.** Experiment with different position welding gun. Remember that the grip you choose comfortable so you can hold the gun for long periods of time. Try at least three different positions. Write detailing your findings. (16.2)
- 3. Critical Thinking.** Consider the GMAW and FCAW processes. Which process, in your opinion, require cleaning between passes on a multipass weld? Write explaining your answer. (16.3)

## Communicating about Welding

- 1. Writing.** Imagine you have been asked to teach new welding students who know nothing about forehand and backhand welding. How would you describe these two techniques and explain when each of them is used? What phrases would you use? Write up your lesson. (16.2)
- 2. Speaking.** Working with a partner, study a sheet of thin-gauge aluminum. Note the properties of the aluminum. Try different experiments to learn about these properties. Discuss what problems these properties could cause in welding. Revisit the information in this chapter and share your thoughts about the challenges of welding aluminum. Compare your findings with another group's findings. (16.3)



# End-of-Chapter Content

## 8 Welding Symbols and Print Reading ▼

- 📖 Chapter 8 Review
- 📖 Job 8-1: Lay Out and Fabricate a Part from a Drawing
- 📖 Job 8-2: Reading an AWS Welding Symbol
- 📖 Job 8-3: Drawing an AWS Welding Symbol

## Section 2 Shielded Metal Arc Welding ▼

- 📖 Shielded Metal Arc Welding Safety Test

## 9 SMAW: Equipment and Supplies ▼

- 📖 Chapter 9 Review

## 10 SMAW: Equipment Assembly and Adjustment ▼

- 📖 Chapter 10 Review
- 📖 Job 10-1: Performing a Safety Inspection of a Shielded Metal Arc Welding Station

## 11 SMAW: Electrodes ▼

- 📖 Chapter 11 Review

## 12 SMAW: Flat Welding Position ▼

- 📖 Chapter 12 Review
- 📖 Job 12-1: Running a Weld Bead in the Flat Welding Position
- 📖 Job 12-2: Welding a Lap Joint in the Flat Welding Position
- 📖 Job 12-3: Welding a T-Joint in the Flat Welding Position
- 📖 Job 12-4: Welding a V-Groove Outside Corner Joint in the Flat Welding Position
- 📖 Job 12-5: Welding a V-Groove Butt Joint
- 📖 Job 12-6: Welding a V-Groove Butt Joint with Backing

Name:  
Date:  
Class:

### Chapter 12: SMAW: Flat Welding Position

#### Job 12-1: Running a Weld Bead in the Flat Welding Position

**Objective:** In this job, you will learn to make satisfactory stringer and weave the SMAW process. You will also learn to read a weld bead.

#### Note

Do not attempt this job until:

- You have read all safety precautions.
  - You have satisfactorily completed the *Shielded Metal Arc Welding (SMAW) Safety Test*.
  - You have received permission from your instructor.
1. Obtain three pieces of carbon steel that measure  $1/4" \times 6" \times 6"$  (6 mm  $150$  mm). Also, obtain three each of the following electrodes:
    - $1/8"$  (3.2 mm) diameter E6010.
    - $5/32"$  (4 mm) diameter E6012.
    - $1/8"$  (3.2 mm) diameter E6013.
    - $5/32"$  (4 mm) diameter E7018 (or other iron powder electrode).

Diameter:  $1/8"$  (3 mm)

Designation: E6010

Amperage Range Min.:

Amperage Range Max.:

Polarity:

Diameter:  $5/32"$  (4 mm)

Designation: E6012

Name:  
Date:  
Class:

### Chapter 11: SMAW: Electrodes

#### Chapter Review

**Objective:** You will be able to identify carbon and low alloy electrodes using the AWS electrode identification system. You will also be able to describe how to select the correct electrode, electrode diameter, polarity, and amperage for the weld being made.

#### Instructions

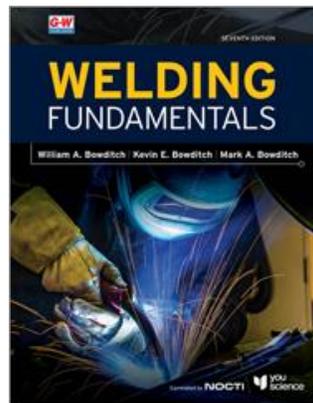
Carefully read Chapter 11 of the textbook and study the figures. Then, answer or complete the following questions.

1. The AWS A5.5 is a list of electrodes used to weld which type of metal?
  - A. Copper and copper alloys.
  - B. Carbon steels.
  - C. Low alloy steels.
  - D. Gray and ductile iron.
  - E. Corrosion-resistant steels.

Answer:
2. Electrodes are produced in lengths of  $12"$  (300 mm), \_\_\_\_\_" (\_\_\_\_\_ mm), and  $18"$  (450 mm).
 

Answer:
3. Electrodes are produced in \_\_\_\_\_ different diameters.
  - A. 10
  - B. 9
  - C. 8
  - D. 7
  - E. 16

Answer:
4. The covering on an electrode has which of the following purposes?
  - A. Add filler metal to the weld.
  - B. Create a gas to protect the arc and metal.



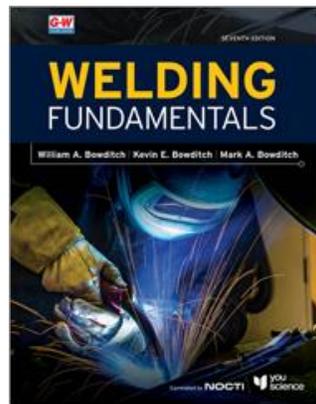
## 12 SMAW: Flat Welding Position ▼

- E-Flash Cards
- Matching Activity
- Vocabulary Game
- Scratch Starting Method Video
- Pecking Motion Method Video
- Electrode Problem Solving Video
- First Step to Striking an Arc Video
- Proper Electrode Distance Video
- Finding the Arc Length Video
- Stringer and Weave Bead Widths Video
- Bead and Weld Cleaning Video
- Restarting a Bead Video
- SMAW Joint Configurations Video
- Tack Welds Video
- Welding with an E6010 Electrode Video
- Review (DOCX, 37 KB)

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### 3 Welding and Cutting Processes ▼

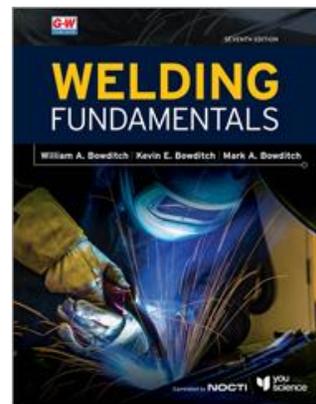
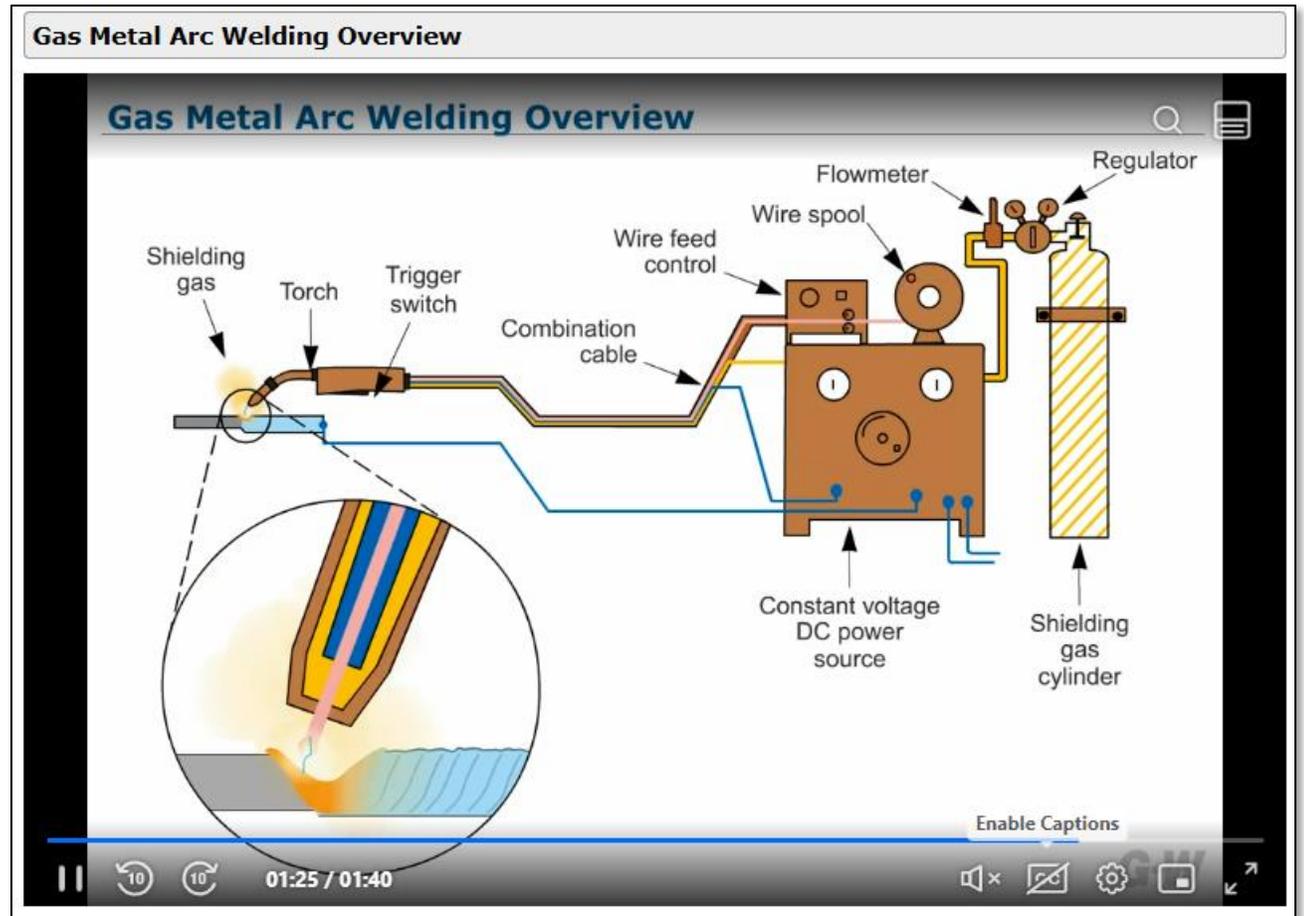
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- ▶ Gas Tungsten Arc Welding Overview
- ▶ Gas Metal Arc Welding Overview
- ▶ Flux Cored Arc Welding Overview
- ▶ Oxyacetylene Welding Overview
- ▶ Oxyfuel Gas Cutting Overview
- ▶ Air Carbon Arc Gouging Overview

### 4 The Physics of Welding ▼

- ▶ Compensating for Weld Contraction
- ▶ Types of Stresses

### 9 SMAW: Equipment and Supplies ▼

- ▶ DCEN and DCEP Circuits and Current Flow
- ▶ Amperage Lag in AC Welding Machines



**Animation Video Library**





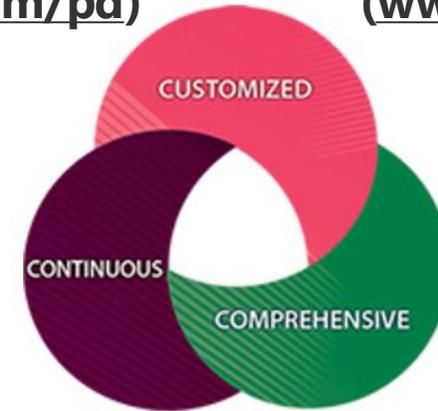
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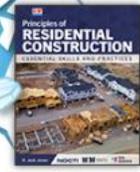
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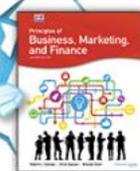
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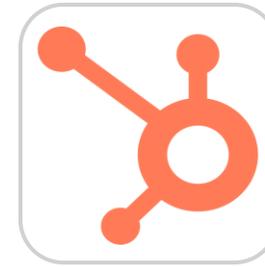


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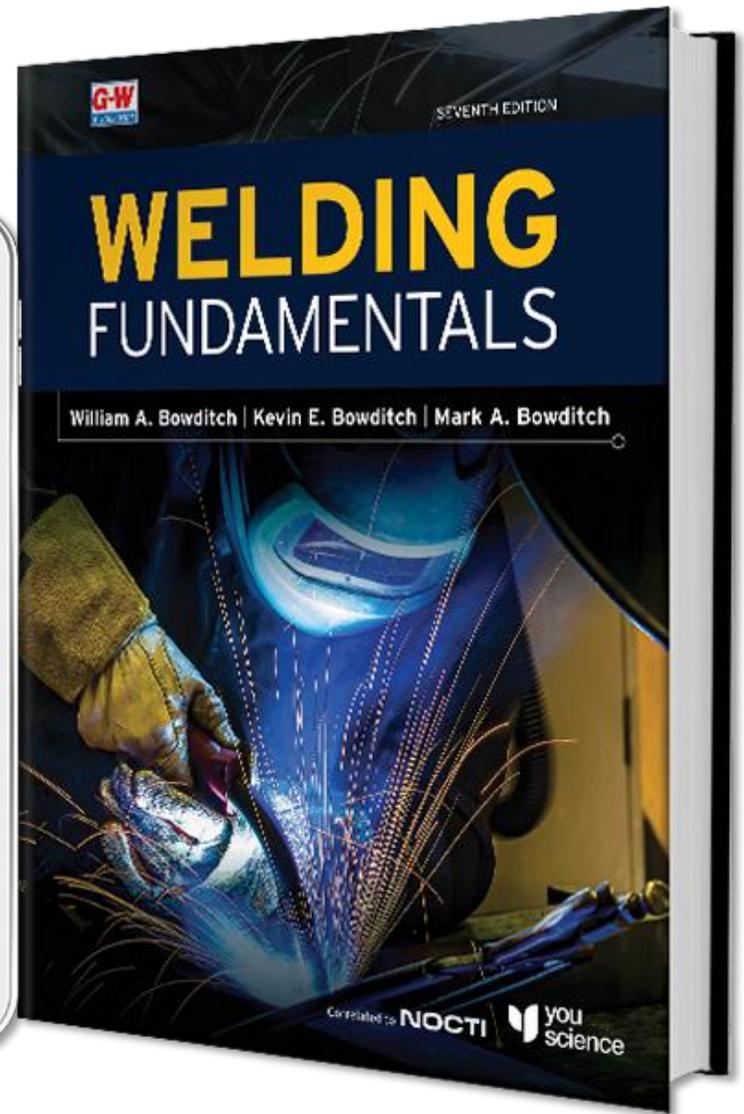
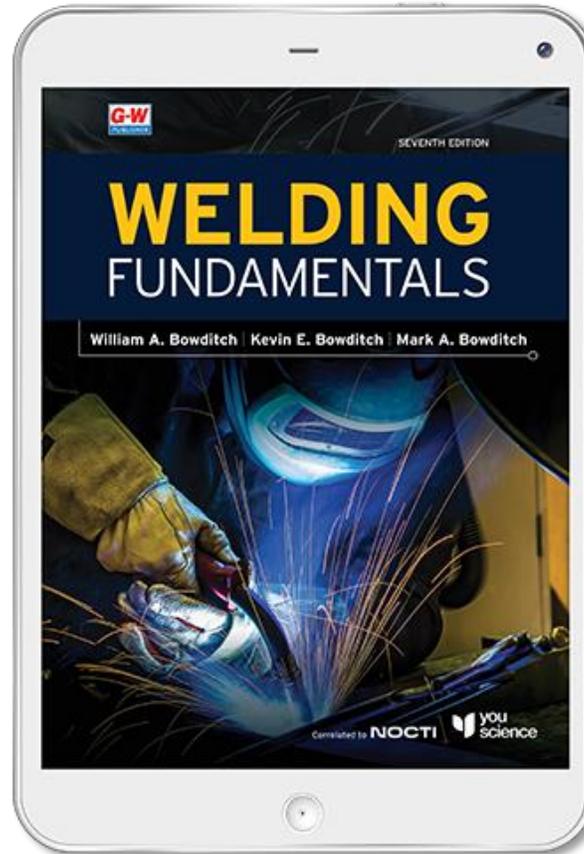


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