Preface

Oxyfuel Gas Welding and Cutting presents the fundamentals of this skilled trade in an easy-to-understand manner. Each unit includes activities for you, the student welder, to complete.

Oxyfuel gas welding requires a great deal of practice to produce satisfactory weldments. To become a good welder, you will have to spend many hours running beads and making the joints presented in this write-in text. Read the text matter carefully, study and complete the questions, and perform the activities as required. This will aid you in developing skills and techniques that will enable you to enter the welding industry and to prepare yourself for many career opportunities.

Each practice piece should be evaluated, and every effort should be made to correct any problem encountered. Where possible, test each weld for integrity, penetration, and appearance. Your instructor will help you do this. To conserve material, it is recommended that both sides of the practice piece be used whenever practical. Identify your work by stamping your name or initials on each practice piece.

The questions in the Check Your Progress section at the end of each unit will help you determine how well you understand the information provided. Additional up-to-date welding know-how can be acquired by carrying out the suggested activities.

About the Authors

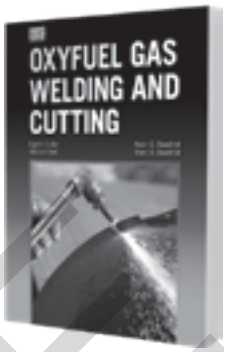
Kevin E. Bowditch is a retired welding engineer specialist for Subaru of Indiana Automotive Inc. His welding experience includes working for two automotive firms, two aerospace firms, a construction company (building nuclear plants), and a precision sheet metal firm. His initial welding training was at the Hobart Institute of Welding Technology. He earned his bachelor's degree in welding engineering from The Ohio State University, and has attended specialized conferences and courses sponsored by the American Welding Society, American Society of Mechanical Engineers, and American National Standards Institute. At Subaru, he helped develop and validate welding parameters to make over one billion spot and arc welds per year. Kevin Bowditch joined his father as a coauthor of *Modern Welding*, beginning with the 1984 edition, and has been a coauthor of *Welding Fundamentals* since its first edition was published in 1991.

Mark A. Bowditch joined the Bowditch team of welding authors in 1998, when he coauthored *Oxyfuel Gas Welding* with his brother Kevin Bowditch. Mark Bowditch has more than 10 years of experience as an educator, holds bachelor's, master's, and doctoral degrees, and has taken classes at the Hobart Institute of Welding Technology. In addition to employing his expertise and communication skills in preparing this edition of *Oxyfuel Gas Welding and Cutting*, he has also assumed responsibility as a coauthor with his brother and father for the 2005 and later revisions of *Welding Fundamentals* and *Modern Welding*. He is also an officer in the United States Air Force Reserves.

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TOOLS FOR STUDENT AND INSTRUCTOR SUCCESS

Student Tools



Oxyfuel Gas Welding and Cutting provides students with a simple, unintimidating, and clear text to use when learning oxyfuel gas welding, cutting, and allied processes (brazing, braze welding, and torch soldering). This write-in text is divided into 35 small, easy-to-understand units, with a series of review questions at the end of the unit to reinforce and evaluate student learning. The first section of the book, units 1–4, provides students with the general welding knowledge they need in order to successfully study and apply oxyfuel processes. This includes measurement, safety, and the interpretation of the welding symbols used in construction drawings. Subsequent units guide students through learning the various processes in small increments. This incremental approach ensures that students can thoroughly understand theory and master technique before proceeding to the next step.

Instructor Tools

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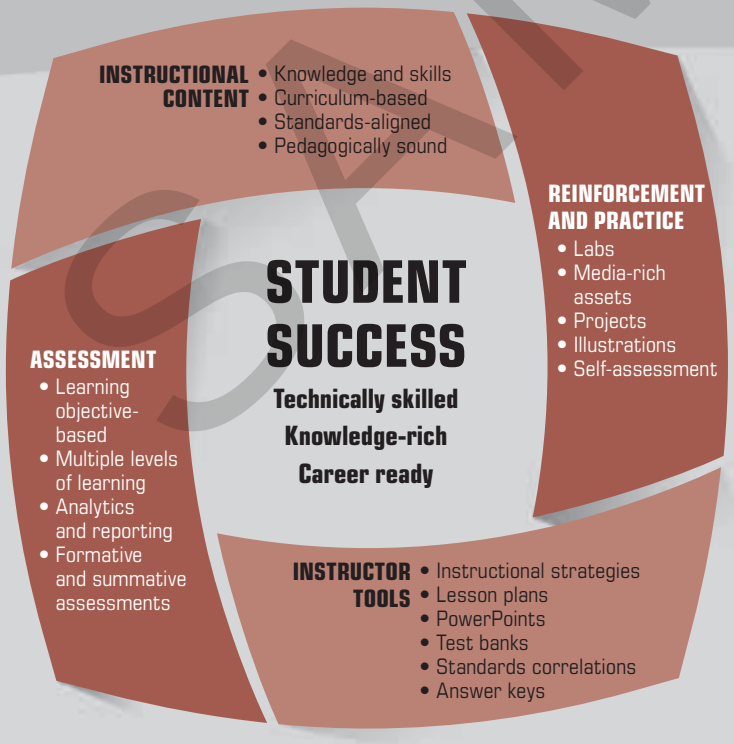
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Features of the Textbook

The instructional design of this textbook includes student-focused learning tools to help you succeed. This visual guide highlights these features.

Features

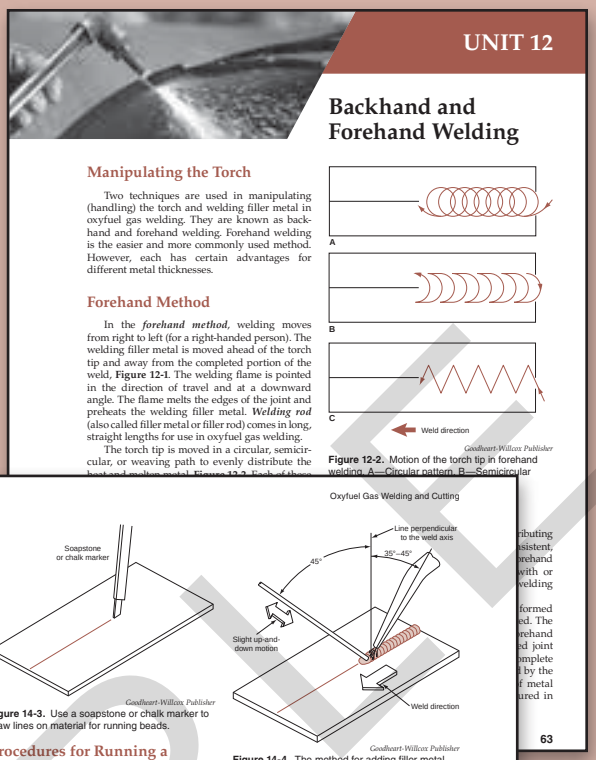
Safety Information is presented in a second color to alert you to potentially dangerous materials and practices. **Procedures** are provided throughout the textbook to provide clear instructions for hands-on service activities.

Illustrations

Illustrations have been designed to clearly and simply communicate the specific topic. Photographic images have been updated to show the latest equipment.

End-of-Unit Content

End-of-unit material provides an opportunity for review and application of concepts. **Check Your Progress** questions enable you to demonstrate knowledge, identification, and comprehension of chapter material. **Things to Do** extend your learning and help you apply knowledge.


UNIT 12

Backhand and Forehand Welding

Manipulating the Torch

Two techniques are used in manipulating (handling) the torch and welding filler metal in oxyfuel gas welding. They are known as backhand and forehand welding. Forehand welding is the easier and more commonly used method. However, each has certain advantages for different metal thicknesses.

Forehand Method

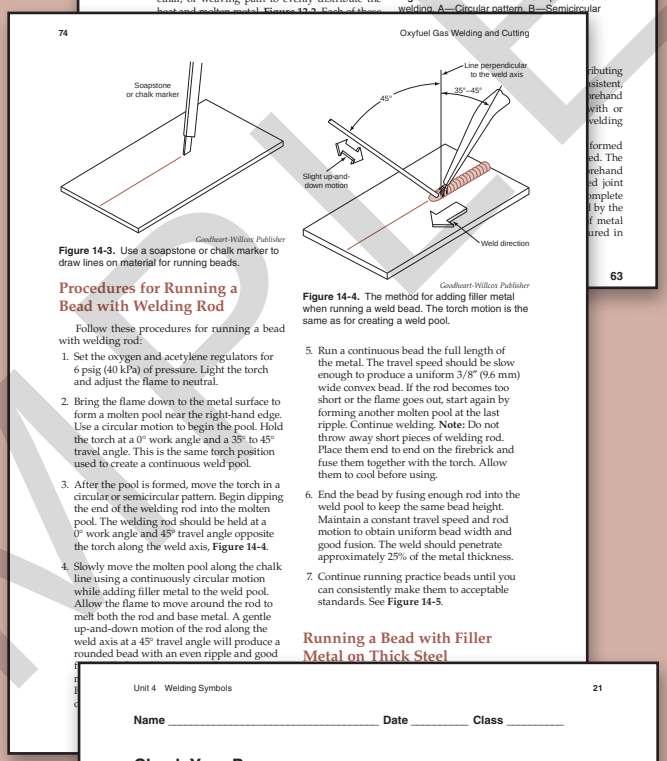
In the ***forehand method***, welding moves from right to left (for a right-handed person). The welding filler metal is moved ahead of the torch tip and away from the completed portion of the weld, **Figure 12-1**. The welding flame is pointed in the direction of travel and at a downward angle. The flame melts the edges of the joint and preheats the welding filler metal. ***Welding rod*** (also called filler metal or filler rod) comes in long, straight lengths for use in oxyfuel gas welding.

The torch tip is moved in a circular, semicircular, or weaving path to evenly distribute the

A
B
C
Weld direction

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Figure 12-2. Motion of the torch tip in forehand welding. A—Circular pattern. B—Semicircular


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Oxyfuel Gas Welding and Cutting

Soapstone or chalk marker

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Figure 14-3. Use a soapstone or chalk marker to draw lines on material for running beads.

Line perpendicular to the weld axis
35°–45°
45°
Slight up-and-down motion
Weld direction

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Figure 14-4. The method for adding filler metal when running a weld bead. The torch motion is the same as for creating a weld pool.

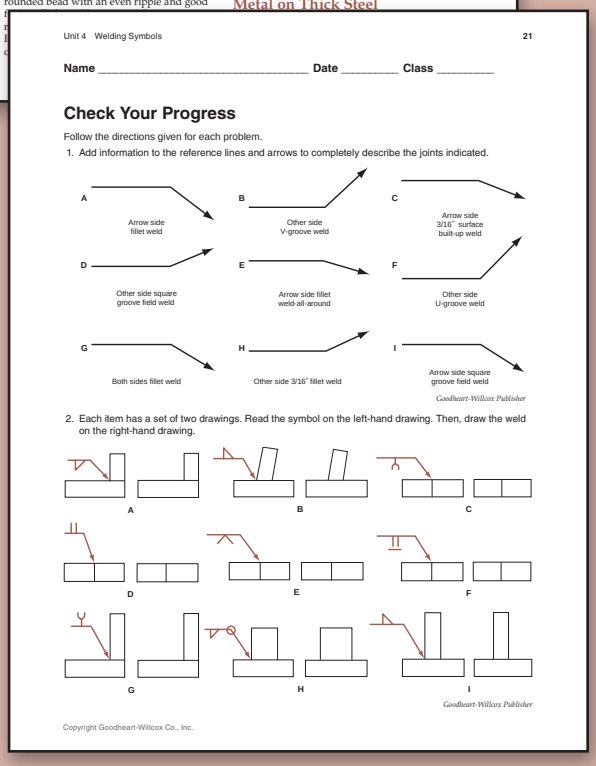
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Procedures for Running a Bead with Welding Rod

Follow these procedures for running a bead with welding rod:

1. Set the oxygen and acetylene regulators for 6 psig (40 kPa) of pressure. Light the torch and adjust the flame to neutral.
2. Bring the flame down to the metal surface to form a molten pool near the right-hand edge. Use a circular motion to begin the pool. Hold the torch at a 0° work angle and a 35° to 45° travel angle. This is the same torch position used to create a continuous weld pool.
3. After the pool is formed, move the torch in a circular or semicircular pattern. Begin dipping the end of the welding rod into the molten pool. The welding rod should be held at a 0° work angle and 45° travel angle opposite the torch along the weld axis, **Figure 14-4**.
4. Slowly move the molten pool along the chalk line using a continuously circular motion while adding filler metal to the weld pool. Allow the flame to move around the rod to melt both the rod and base metal. A gentle up-and-down motion of the rod along the weld axis at a 45° travel angle will produce a rounded bead with an even ripple and good
5. Run a continuous bead the full length of the metal. The travel speed should be slow enough to produce a uniform 3/8″ (9.6 mm) wide convex bead. If the rod becomes too short or the flame goes out, start again by forming another molten pool at the last ripple. Continue welding. **Note:** Do not throw away short pieces of welding rod. Place them end to end on the firebrick and fuse them together with the torch. Allow them to cool before using.
6. End the bead by fusing enough rod into the weld pool to keep the same bead height. Maintain a constant travel speed and rod motion to obtain uniform bead width and good fusion. The weld should penetrate approximately 25% of the metal thickness.
7. Continue running practice beads until you can consistently make them to acceptable standards. See **Figure 14-5**.

Running a Bead with Filler Metal on Thick Steel


Unit 4 Welding Symbols 21

Name _____ Date _____ Class _____

Check Your Progress

Follow the directions given for each problem.

1. Add information to the reference lines and arrows to completely describe the joints indicated.

A Arrow side fillet weld
B Other side V-groove weld
C Arrow side 3/16″ surface built-up weld
D Other side square groove field weld
E Arrow side fillet weld-all-around
F Other side U-groove weld
G Both sides fillet weld
H Other side 3/16″ fillet weld
I Arrow side square groove field weld

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2. Each item has a set of two drawings. Read the symbol on the left-hand drawing. Then, draw the weld on the right-hand drawing.

A B C D E F G H I

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Acknowledgments

The author and publisher would like to thank the following companies, organizations, and individuals for their contribution of resource material, images, or other support in the development of *Oxyfuel Gas Welding and Cutting*:

American Torch Tip Co.
American Welding Society
Linde BmbH, Munich
Miller Electric Mfg. LLC
Uniweld Products, Inc.
The ESAB Group, Inc.

New to This Edition

For this edition of *Oxyfuel Gas Welding and Cutting*, numerous photos have been replaced to show updated equipment and to reflect changes among equipment manufacturers. The text was reviewed to ensure it is accurate and up-to-date. Notable changes for this edition include the following:

- Title changed to reflect the cutting content included in the book.
- In chapter 4, Figures 4-1 and 4-4 were updated to reflect changes in AWS A2.4 standards.
- Added a Procedures table of contents to help students quickly locate hands-on activities to practice in the welding lab.

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