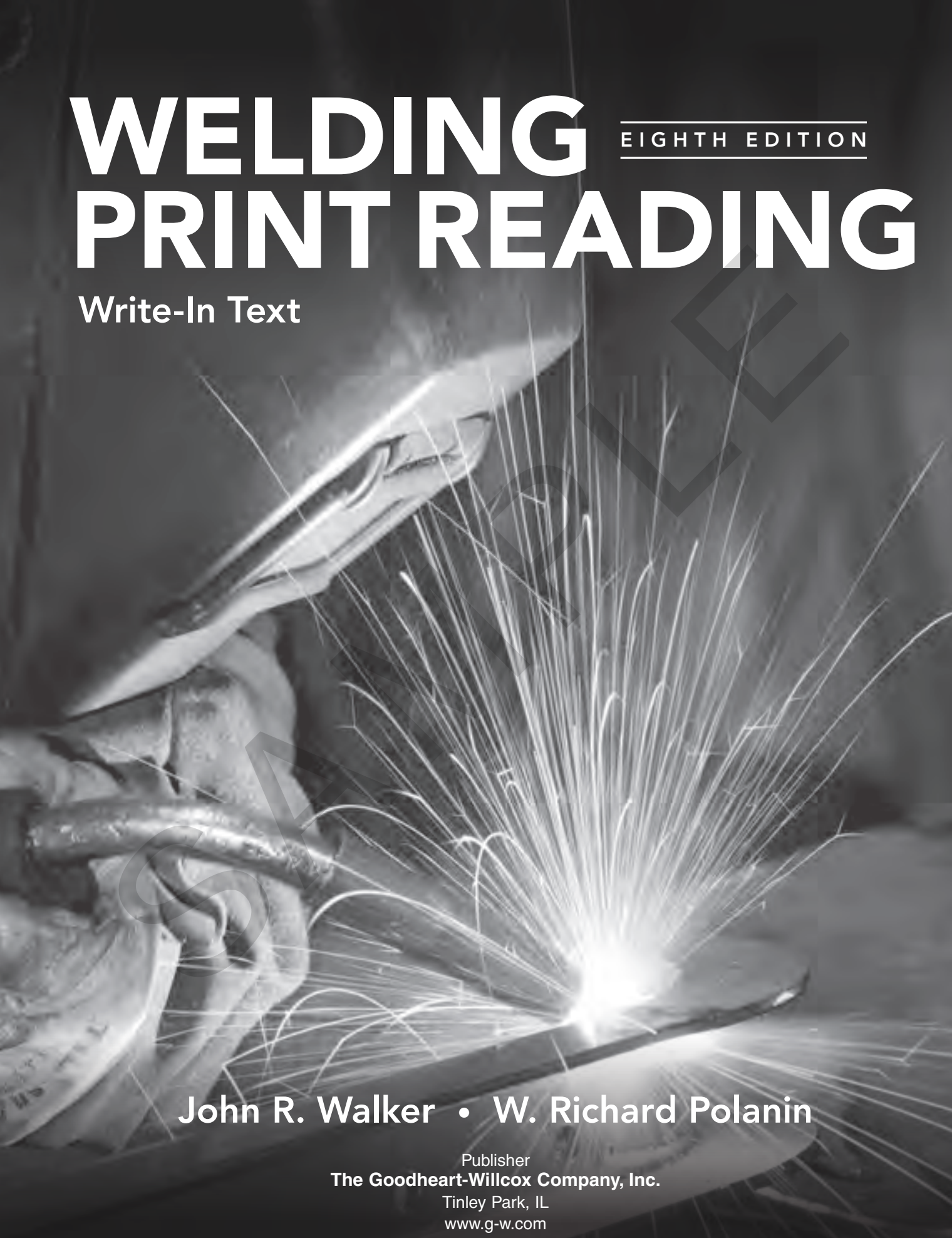
WELDING PRINT READING

EIGHTH EDITION

Write-In Text



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Preface

Just about every manufactured product uses welding, either directly or indirectly. Over the years, a system of symbols and notations has been developed to convey exact weld specifications. Welding symbols and notations allow a large amount of data about a weld to be condensed into a small amount of space on a print. They simplify communications between the designer/engineer and the welder, and also between other workers associated with the production of a weldment. Symbols and notations help assure that welds meet design requirements.

A welder, or anyone else (technician, engineer, drafter, etc.) working with welding prints, must know how to use the welding symbols and notations. This text is designed to help you grasp this information as quickly and easily as possible.

Welding Print Reading provides instruction on interpreting and using the type of engineering drawings and prints found in the welding trade. It is a write-in text, or text-workbook, that starts out with the basics and progresses to more specialized coverage of specific welding symbols and notations. The information in this text follows to the most recent standards set up by the American Welding Society (AWS) and the American National Standards Institute (ANSI). However, this text is based on actual prints that are used in industry. While most industry practices conform to the national standards, any variation in a particular print has been retained for realistic experience. This will prepare you to work with prints being used in industry today.

This text is intended for students in high schools, vocational/technical schools, community colleges, for apprentices, and for workers on the job. It may also be used as a self-study course for those unable to attend print reading classes.

Each unit is designed to deliver complete coverage of specific welding print reading topics. Example prints, illustrations, symbols, and notations are used throughout each unit to reinforce these topics. At the end of each unit, there are problems that deal with the topics covered in the unit. These problems are used to review the key concepts learned in the unit.

Unit 25, Print Reading Activities, consists of additional prints and related questions. These activities are designed to give you the opportunity for added practice of your welding print reading skills. It is suggested that these activities be performed after the completion of the first 24 units, but they may be used anytime as a review.

About the Authors

Each author has many years of experience in the teaching, welding, and print reading fields. They are confident that you will find this text a tremendous tool for learning how to read and interpret welding prints.

John R. Walker

John R. Walker is the author of thirteen textbooks and has written many magazine articles. Mr. Walker did his undergraduate studies at Millersville University and has a Master of Science degree in Industrial Education from the University of Maryland. He taught industrial arts and vocational education for thirty-two years and was Supervisor of Industrial Education for five years. He also worked as a machinist for the U.S. Air Force and as a draftsman at the U.S. Army Aberdeen Proving Grounds.

W. Richard Polanin

Dr. W. Richard Polanin is a retired professor and program chair of the Manufacturing Engineering Technology and Welding Technology programs at Illinois Central College. He is the Co-Principal Investigator for Weld-Ed, the National Center for

Welding Education and Training. He is also the Principal Investigator for a Weld-Ed project in collaboration with the American Society for Nondestructive Testing to identify nondestructive testing technician student learning outcomes.

Dr. Polanin is also a consultant in manufacturing engineering, and welding engineering and inspection. He has published numerous papers and has made many technical presentations in the areas of manufacturing, robotics, welding, and manufacturing education.

Dr. Polanin holds bachelor's and master's degrees from Illinois State University and a doctorate degree from the University of Illinois. He is a graduate of the Illinois Scholars Program sponsored by the Illinois State Board of Education and the Illinois Community College Board. He is also a Certified Manufacturing Engineer, a Certified Welding Inspector, and a Certified Welding Educator. Dr. Polanin was elected to the AWS 2014 Class of Counselors and Fellows and is currently President-Elect of the American Welding Society.

Reviewers

The authors and publisher wish to thank the following industry and teaching professionals for their valuable input into the development of *Welding Print Reading*.

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The Weld-Ed Mission: Enriched Curricula, Enhanced Educators

Weld-Ed, in collaboration with business and industry, improves the quality, quantity, and availability of welding technicians through the advancement of educational curriculum and professional development for instructors.

To accomplish this mission, the Center's staff and partners work collaboratively on the development of new and improved curricula in all areas of the materials joining industry. As a result of these efforts, faculty and instructors are provided continuing education opportunities throughout the academic year and summer months.

These programs are specifically designed to train the next generation of workers for the materials joining industry, while enhancing the skills of incumbent workers.

For more information about Weld-Ed, visit www.Weld-Ed.org.

New to This Edition

This edition of *Welding Print Reading* contains the following enhancements to help students succeed.

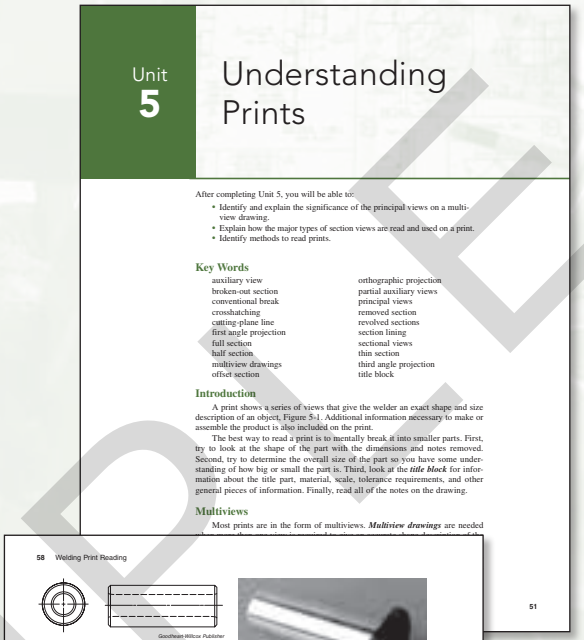
- Unit 1 has been updated to reflect the latest industry practices.
- A new section on 3D modeling has been added to the text.
- New information on the use of cobots in the welding field has been added to Unit 10.
- New images showing current equipment have been added to the text.

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.

Unit Opening Materials

Each unit opener contains unit outcomes, key words, and an introduction. The **Unit Outcomes** clearly identify the knowledge and skills to be gained when the unit is completed. **Key Words** list the important terms to be learned in the unit. The **Introduction** provides an overview and preview of the unit content.



Unit 5

Understanding Prints

After completing Unit 5, you will be able to:

- Identify and explain the significance of the principal views on a multiview drawing.
- Explain how the major types of section views are read and used on a print.
- Identify methods to read prints.

Key Words

auxiliary view
broken-out section
conventional break
crosshatching
cutting-plane line
first angle projection
full section
half section
multiview drawings
offset section
orthographic projection
partial auxiliary views
principal views
removed section
revolved sections
section lining
sectional views
thin section
third angle projection
title block

Introduction

A print shows a series of views that give the welder an exact shape and size description of an object, Figure 5-1. Additional information necessary to make or assemble the product is also included on the print.

The best way to read a print is to mentally break it into smaller parts. First, try to look at the shape of the part with the dimensions and notes removed. Second, try to determine the overall size of the part so you have some understanding of how big or small the part is. Third, look at the ***title block*** for information about the title part, material, scale, tolerance requirements, and other general pieces of information. Finally, read all of the notes on the drawing.

Multiviews

Most prints are in the form of multiviews. ***Multiview drawings*** are needed

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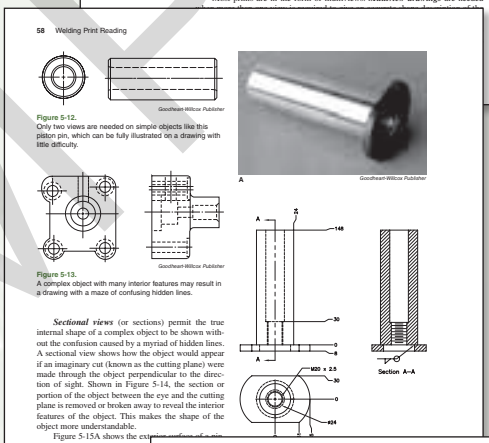

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Figure 5-12.
Only two views are needed on simple objects like this piston pin, which can be fully illustrated on a drawing with little difficulty.

A

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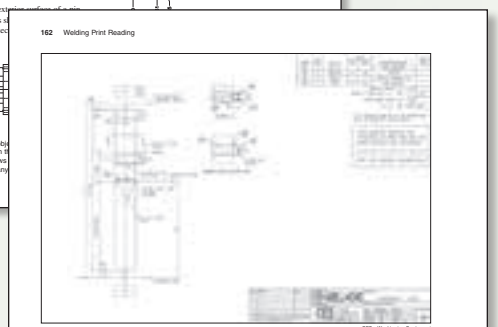
Figure 5-13.
A complex object with many interior features may result in a drawing with a maze of confusing hidden lines.

Sectional views (or sections) permit the true internal shape of a complex object to be shown without the confusion caused by a myriad of hidden lines. A sectional view shows how the object would appear if an imaginary cut (known as the cutting plane) were made through the object perpendicular to the direction of sight. Shown in Figure 5-14, the section or portion of the object between the eye and the cutting plane is removed or broken away to reveal the interior features of the object. This makes the shape of the object more understandable.

Figure 5-15A shows the ex
Notice that the interior features s
are easier to visualize if a full sec

Figure 5-14.
A sectional view shows how an obj
imaginary cut were made through t
to the direction of sight. This allows
seen without the confusion of many

Section A–A



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CES—Washington Equipment

Figure 12-2.
The assembly shown in this structural steel drawing is made from stock structural shapes.

metallic element. When a pure metal is used as the principal alloying agent in an alloy, it is known as a ***base metal***.

There are no simple answers to these questions. Additional study and experience, however, can help a welder develop a working knowledge of metals to make the job safer, easier, and more successful.

Metals Supplied for Welding

The welder usually has little or no control over the metal furnished for welding. It must be assumed metal provided by the employer for a specific job meets print specifications. The metal supplier or the mill that produced the metal can certify the metallurgical characteristics of a metal.

As a welder, it is important to know the characteristics of the metal(s) you will be welding. This is important for three reasons:

- It aids in ensuring the welds meet design specifications.
- It permits you to take special safety precautions when welding metals that give off toxic fumes and residue.
- It allows you to match the filler metal to the base metal.

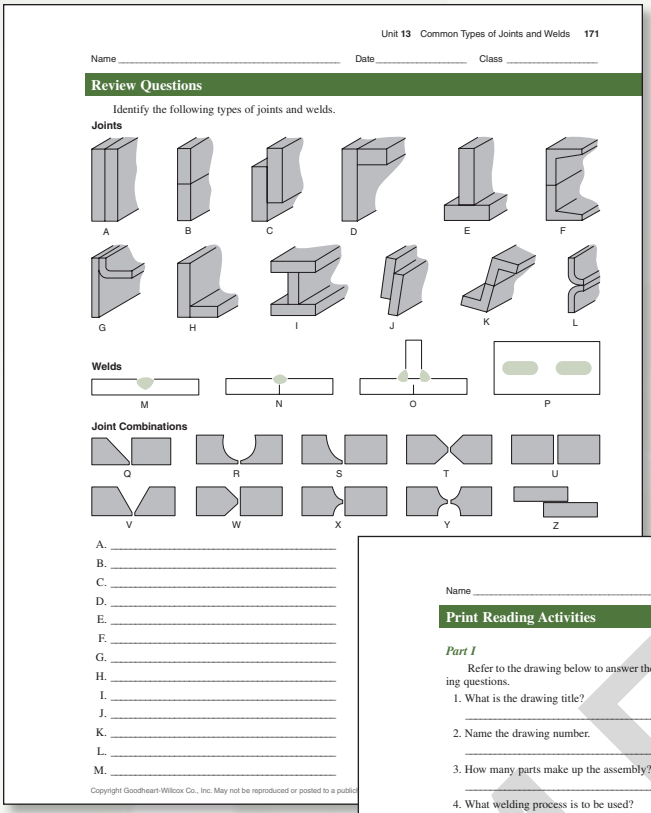
Metal Specifications

Metal specifications, or specs, are usually located in a special section of the title block. Figure 12-3 shows an example. There are times when the metal specs may be given elsewhere on the drawing.

You can think about metals in a variety of ways. For example, you can think about a metal's shape, finish, atomic structure, alloy elements, and strength. For those who work with metals extensively, a more specific method of specifying metals may be needed. Professional organizations, the military, steel mills, testing laboratories, and companies may have a detailed method of specifying metals. A few common

Illustrations and Sample Prints

Illustrations have been designed to clearly and simply communicate the specific topic. **Sample prints** provide examples of the types of welding prints encountered in industry.



Unit 13 Common Types of Joints and Welds 171

Name _____ Date _____ Class _____

Review Questions

Identify the following types of joints and welds.

Joints

A B C D E F

G H I J K L

Welds

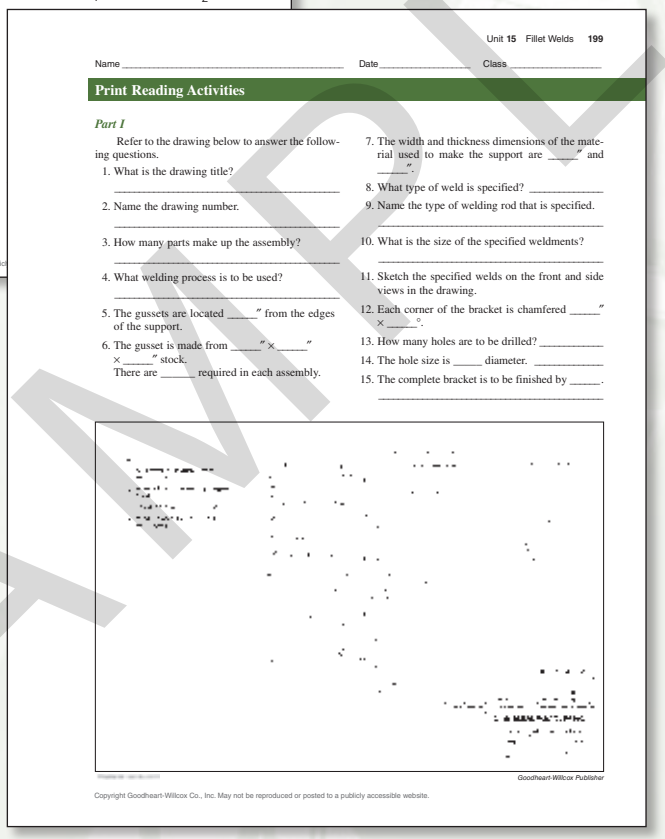
M N O P

Joint Combinations

Q R S T U

V W X Y Z

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____
M. _____



Unit 15 Fillet Welds 199

Name _____ Date _____ Class _____

Print Reading Activities

Part I

Refer to the drawing below to answer the following questions.

1. What is the drawing title? _____
2. Name the drawing number. _____
3. How many parts make up the assembly? _____
4. What welding process is to be used? _____
5. The gussets are located _____″ from the edges of the support.
6. The gusset is made from _____″ × _____″ × _____″ stock. There are _____ required in each assembly.
7. The width and thickness dimensions of the material used to make the support are _____″ and _____″.
8. What type of weld is specified? _____
9. Name the type of welding rod that is specified. _____
10. What is the size of the specified weldments? _____
11. Sketch the specified welds on the front and side views in the drawing.
12. Each corner of the bracket is chamfered _____″ × _____°.
13. How many holes are to be drilled? _____
14. The hole size is _____ diameter. _____
15. The complete bracket is to be finished by _____. _____

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End-of-Unit Content

End-of-unit material provides an opportunity for review and application of concepts. **Review Questions** allow you to demonstrate your comprehension of unit material. **Print Reading Activities** at the ends of the units allow you to apply the concepts learned in the unit.

TOOLS FOR STUDENT AND INSTRUCTOR SUCCESS

Student Tools

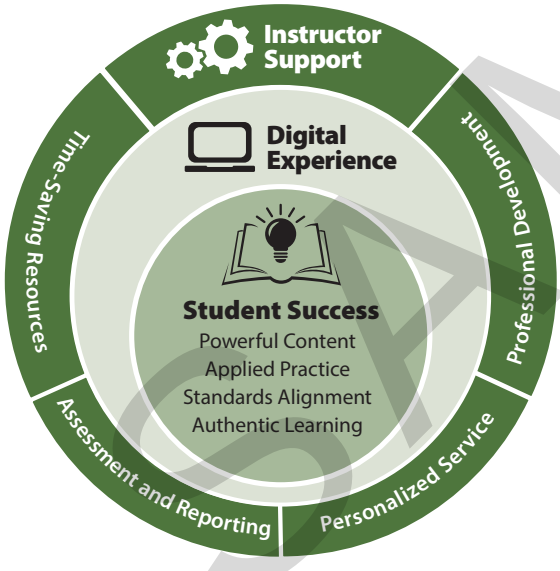
Student Text

Welding Print Reading is a write-in text that teaches the welding symbols and specifications students need to understand to be successful. The text starts by reviewing the basics, including welding processes, and then progresses to more specialized topics, such as prints for pipe welding and brazed joints.

G-W Digital Companion

For digital users, e-flash cards and vocabulary exercises allow interaction with content to create opportunities to increase achievement.

G-W Ignite
Skillful Digital Learning



Instructor Tools

LMS Integration

Integrate Goodheart-Willcox content within your Learning Management System for a seamless user experience for both you and your students. EduHub LMS–ready content in Common Cartridge® format facilitates single sign-on integration and gives you control of student enrollment and data. With a Common Cartridge integration, you can access the LMS features and tools you are accustomed to using and G-W course resources in one convenient location—your LMS.

G-W Common Cartridge provides a complete learning package for you and your students. The included digital resources help your students remain engaged and learn effectively:

- **Digital Textbook**
- **Drill and Practice** vocabulary activities

When you incorporate G-W content into your courses via Common Cartridge, you have the flexibility to customize and structure the content to meet the educational needs of your students. You may also choose to add your own content to the course.

For instructors, the Common Cartridge includes the Online Instructor Resources. QTI® question banks are available within the Online Instructor Resources for import into your LMS. These prebuilt assessments help you measure student knowledge and track results in your LMS gradebook. Questions and tests can be customized to meet your assessment needs.

Online Instructor Resources

- The **Instructor Resources** provide instructors with time-saving preparation tools such as answer keys, editable lesson plans, and other teaching aids.
- **Instructor's Presentations for PowerPoint®** are fully customizable, richly illustrated slides that help you teach and visually reinforce the key concepts from each unit.
- Administer and manage assessments to meet your classroom needs using **Assessment Software with Question Banks**, which include hundreds of matching, completion, multiple choice, and short answer questions to assess student knowledge of the content in each unit.

See **www.g-w.com/welding-print-reading-2024** for a list of all available resources.

Professional Development

- Expert content specialists
- Research-based pedagogy and instructional practices
- Options for virtual and in-person Professional Development

Brief Contents

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Print Reading Basics

Welding Fundamentals

Reading Welding Prints

Manufacturing and Testing for Industry

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