Preface

Modern Residential Wiring provides you with a solid background of electrical principles and practices, as well as a thorough understanding of the *National Electrical Code*®*. When the information provided here is mastered, you will be well equipped to design and install modern and safe residential wiring systems that meet the electrical power demands of today's world.

Modern Residential Wiring covers not only the "how" but also the "why" of safe electrical wiring practices. Although the content is concerned primarily with residential installations, many of the same concepts and principles may be applied to commercial and industrial electrical construction. The chapters are arranged in a logical sequence. The order of instruction follows the normal order in which an installation is made. However, each chapter is designed to stand alone and may be studied independently to suit specific needs.

Modern Residential Wiring makes the study of electrical wiring easy. Even the most complicated procedures are explained in a clear, simple, easy-to-understand manner. Procedures are presented step-by-step, while many illustrations are fully integrated into the easy-to-read text. The illustrations should be carefully examined as they will often clarify and explain the more difficult principles of electricity and the requirements of the *National Electrical Code*.

The principles of electricity remain fixed. However, the methods, materials, and tools of the trade are continuously evolving. *Modern Residential Wiring* presents both the fundamentals of electrical wiring and the latest practices used in the trade. This new edition of *Modern Residential Wiring* is revised to be consistent with changes in trade practices, materials, and the requirements of the 2026 *National Electrical Code*.

The author wishes to express his sincere appreciation to each of the individuals, organizations, and associations that provided input, assistance, and illustrative materials for this new edition. A special thanks to my wife, Linda, for her active assistance in the creation of this edition.

Harvey N. Holzman

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About the Author

Harvey N. Holzman is a licensed master electrician with over 45 years of hands-on experience in several states, including New York, Florida, Kansas, North Carolina, Pennsylvania, and Texas. Besides owning his own electrical contracting services company, Mr. Holzman has worked for several major constructors at both refineries and power-generating stations, providing consulting, supervision, and field engineering. He has been a member of many electrical trade organizations and has trained dozens of individuals, many of whom have gone on to become master electricians.

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Reviewers

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New to This Edition

The following changes were made to the 14th edition of *Modern Residential Wiring* to strengthen the integrated learning solution and to remain current with professional codes:

- Content and tables have been updated to correspond with the 2026 version of the *National Electrical Code*.
- All learning outcomes, summary bullets, and end-of-chapter questions and activities were reviewed and aligned with each one-head section in every chapter, allowing for instructor flexibility in presenting and assigning textbook content in the classroom.

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The *National Electrical Code®*

The most informative and authoritative body of information concerning electrical wiring installation in the United States, and perhaps the world, is the *National Electrical Code® (NEC)*. This code establishes a set of rules, regulations, and criteria for the installation of electrical equipment. Compliance with these methods will result in a safe installation.

The *NEC* is drafted by a team of experts assembled for this purpose by the National Fire Protection Association (NFPA). This team is formally called the *National Electrical Code* committee. They revise and update the *NEC* every three years. It is imperative that anyone installing electrical wiring obtains and studies the *NEC*. Articles and sections of the *NEC* are referred to throughout this text. Although certain portions, tables, and examples are directly quoted from its text, there is enough useful information in the *NEC* that not having it available would be a tremendous hindrance.

The latest edition of the *National Electrical Code* can be purchased from the National Fire Protection Association by visiting their website. Online access to the *National Electrical Code* and over 1,400 NFPA codes and standards is available with an NFPA LiNK® subscription. NFPA LiNK includes all current editions as well as a library of legacy codes and standards going back five editions. Subscribers also have early access to newly released editions before the printed book is available for purchase. To learn more about NFPA LiNK, visit the NFPA website at www.nfpa.org.

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Goodheart-Willcox appreciates the value of industry credentials, certifications, and accreditation. We are pleased to partner with leading organizations to support students and programs in achieving credentials. Integrating industry-recognized credentialing into a career and technical education (CTE) program provides many benefits for the student and for the institution. By achieving third-party certificates, students gain confidence, have proof of a measurable level of knowledge and skills, and earn a valuable achievement to include in their résumés. For educators and administrators, industry-recognized credentials and accreditation validate learning, enhance the credibility of programs, and provide valuable data to measure student performance and help guide continuous program improvement.

Modern Residential Wiring is correlated to electrical credentials offered by NOCTI.

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Goodheart-Willcox is pleased to partner with NOCTI and Nocti Business Solutions (NBS), a leading provider of industry certification solutions for skill verification across the nation. With over 55 years of experience, NOCTI/NBS is a valuable partner both within the CTE community and industry to improve America's workforce. Goodheart-Willcox has created correlations between select products and the standards and competencies that are the basis for NOCTI/NBS credentials, to the benefit of states, instructors, and students working toward NOCTI/NBS credentials.

NOCTI/NBS certifications (knowledge-based and skill-based) are developed by national teams of subject matter experts as part of the process that meets personnel accrediting standards and requirements under ISO 17024, resulting in credentials measuring skills and competencies critical for learner success outside the classroom. NOCTI/NBS offers test development, test delivery, and psychometric services to support skill verification, using the latest tools and methods to provide relevant and helpful solutions for workforce development. For more information about NOCTI, visit www.nocti.org.

To see how *Modern Residential Wiring* correlates to applicable credentialing and certification electrical standards, visit the Correlations tab at www.g-w.com/modern-residential-wiring-2027.

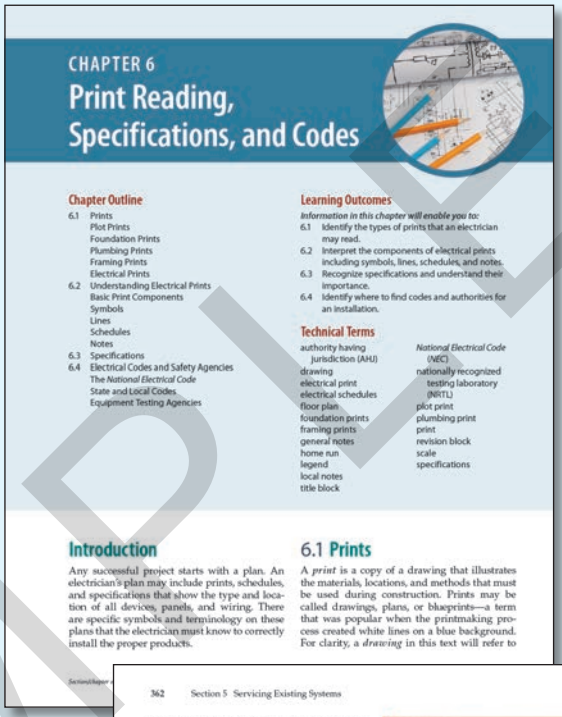
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Features of the Textbook

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

Chapter Opening Materials

Each chapter opener contains a chapter outline, a list of learning outcomes, and a list of technical terms. The **Chapter Outline** summarizes the topics that will be covered in the chapter. **Learning Outcomes** clearly identify the knowledge and skills to be gained when the chapter is completed. These outcomes are labeled and correlated to related assessment elements to facilitate reporting and remediation. **Technical Terms** list the key words to be learned in the chapter. **Introduction** provides an overview and preview of the chapter content.


CHAPTER 6

Print Reading, Specifications, and Codes

Chapter Outline

6.1 Prints
Plot Prints
Foundation Prints
Plumbing Prints
Framing Prints
Electrical Prints
6.2 Understanding Electrical Prints
Basic Print Components
Symbols
Lines
Schedules
Notes
6.3 Specifications
6.4 Electrical Codes and Safety Agencies
The *National Electrical Code*
State and Local Codes
Equipment Testing Agencies

Learning Outcomes

Information in this chapter will enable you to:
6.1 Identify the types of prints that an electrician may read.
6.2 Interpret the components of electrical prints including symbols, lines, schedules, and notes.
6.3 Recognize specifications and understand their importance.
6.4 Identify where to find codes and authorities for an installation.

Technical Terms

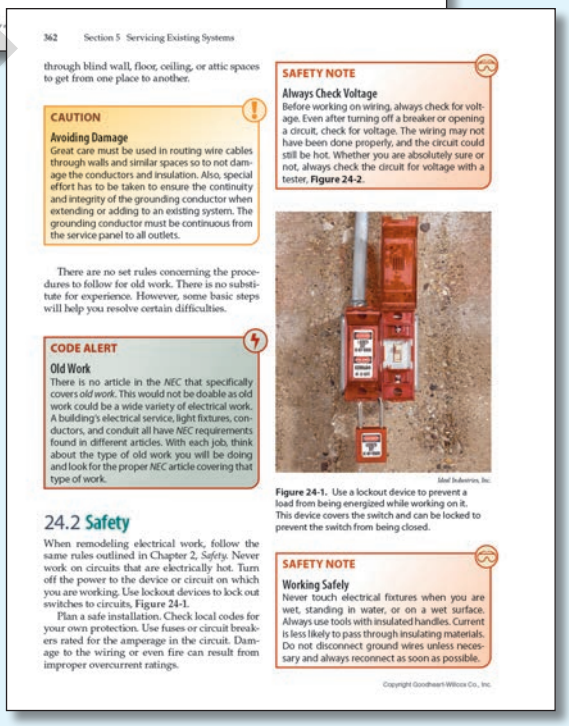
authority having jurisdiction (AHJ)
drawing
electrical print
electrical schedules
floor plan
foundation prints
framing prints
general notes
home run
legend
local notes
title block
National Electrical Code (NEC)
nationally recognized testing laboratory (NRTL)
plot print
plumbing print
print
revision block
scale
specifications

Introduction

Any successful project starts with a plan. An electrician's plan may include prints, schedules, and specifications that show the type and location of all devices, panels, and wiring. There are specific symbols and terminology on these plans that the electrician must know to correctly install the proper products.

6.1 Prints

A *print* is a copy of a drawing that illustrates the materials, locations, and methods that must be used during construction. Prints may be called drawings, plans, or blueprints—a term that was popular when the printmaking process created white lines on a blue background. For clarity, a *drawing* in this text will refer to


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through blind wall, floor, ceiling, or attic spaces to get from one place to another.

CAUTION

Avoiding Damage

Great care must be used in routing wire cables through walls and similar spaces so to not damage the conductors and insulation. Also, special effort has to be taken to ensure the continuity and integrity of the grounding conductor when extending or adding to an existing system. The grounding conductor must be continuous from the service panel to all outlets.

There are no set rules concerning the procedures to follow for old work. There is no substitute for experience. However, some basic steps will help you resolve certain difficulties.

CODE ALERT

Old Work

There is no article in the *NEC* that specifically covers *old work*. This would not be doable as old work could be a wide variety of electrical work. A building's electrical service, light fixtures, conductors, and conduit all have *NEC* requirements found in different articles. With each job, think about the type of old work you will be doing and look for the proper *NEC* article covering that type of work.

24.2 Safety

When remodeling electrical work, follow the same rules outlined in Chapter 2, *Safety*. Never work on circuits that are electrically hot. Turn off the power to the device or circuit on which you are working. Use lockout devices to lock out switches to circuits, Figure 24-1.

Plan a safe installation. Check local codes for your own protection. Use fuses or circuit breakers rated for the amperage in the circuit. Damage to the wiring or even fire can result from improper overcurrent ratings.

SAFETY NOTE

Always Check Voltage

Before working on wiring, always check for voltage. Even after turning off a breaker or opening a circuit, check for voltage. The wiring may not have been done properly, and the circuit could still be hot. Whether you are absolutely sure or not, always check the circuit for voltage with a tester, Figure 24-2.

Figure 24-1. Use a lockout device to prevent a load from being energized while working on it. This device covers the switch and can be locked to prevent the switch from being closed.

SAFETY NOTE

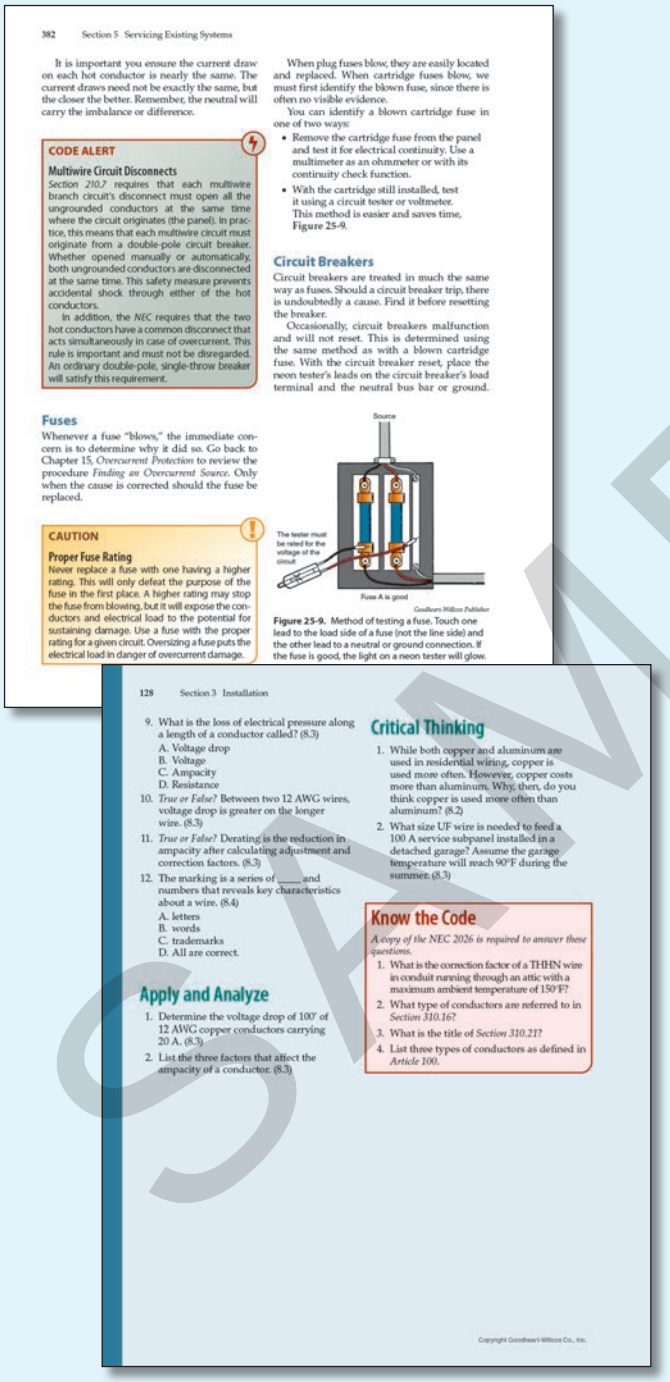
Working Safely

Never touch electrical fixtures when you are wet, standing in water, or on a wet surface. Always use tools with insulated handles. Current is less likely to pass through insulating materials. Do not disconnect ground wires unless necessary and always reconnect as soon as possible.

Additional Features

Additional features are used throughout the body of each chapter to further learning and knowledge. **Safety Notes** alert you to potentially dangerous materials and practices. **Code Alerts** point out specific items from typical building codes. **Procedures** are highlighted throughout the textbook to provide clear instructions for hands-on service activities. **Pro Tips** provide advice and guidance that is especially applicable for on-the-job situations. **Thinking Green** features highlight key items related to sustainability, energy efficiency, and environmental issues.

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It is important you ensure the current draw on each hot conductor is nearly the same. The current draws need not be exactly the same, but the closer the better. Remember, the neutral will carry the imbalance or difference.

CODE ALERT

Multiwire Circuit Disconnects

Section 210.7 requires that each multiwire branch circuit's disconnect must open all the ungrounded conductors at the same time where the circuit originates (the panel). In practice, this means that each multiwire circuit must originate from a double-pole circuit breaker. Whether opened manually or automatically, both ungrounded conductors are disconnected at the same time. This safety measure prevents accidental shock through either of the hot conductors.

In addition, the *NEC* requires that the two hot conductors have a common disconnect that acts simultaneously in case of overcurrent. This rule is important and must not be disregarded. An ordinary double-pole, single-throw breaker will satisfy this requirement.

Fuses

Whenever a fuse "blows," the immediate concern is to determine why it did so. Go back to Chapter 15, *Overcurrent Protection* to review the procedure *Finding an Overcurrent Source*. Only when the cause is corrected should the fuse be replaced.

CAUTION

Proper Fuse Rating

Never replace a fuse with one having a higher rating. This will only defeat the purpose of the fuse in the first place. A higher rating may stop the fuse from blowing, but it will expose the conductors and electrical load to the potential for sustaining damage. Use a fuse with the proper rating for a given circuit. Oversizing a fuse puts the electrical load in danger of overcurrent damage.

When plug fuses blow, they are easily located and replaced. When cartridge fuses blow, we must first identify the blown fuse, since there is often no visible evidence.

You can identify a blown cartridge fuse in one of two ways:

- Remove the cartridge fuse from the panel and test it for electrical continuity. Use a multimeter as an ohmmeter or with its continuity check function.
- With the cartridge still installed, test it using a circuit tester or voltmeter. This method is easier and saves time, **Figure 25-9.**

Circuit Breakers

Circuit breakers are treated in much the same way as fuses. Should a circuit breaker trip, there is undoubtedly a cause. Find it before resetting the breaker.

Occasionally, circuit breakers malfunction and will not reset. This is determined using the same method as with a blown cartridge fuse. With the circuit breaker reset, place the neon tester's leads on the circuit breaker's load terminal and the neutral bus bar or ground.

Figure 25-9. Method of testing a fuse. Touch one lead to the load side of a fuse (not the line side) and the other lead to a neutral or ground connection. If the fuse is good, the light on a neon tester will glow.

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9. What is the loss of electrical pressure along a length of a conductor called? (8.3)
   A. Voltage drop
   B. Voltage
   C. Ampacity
   D. Resistance
10. *True or False?* Between two 12 AWG wires, voltage drop is greater on the longer wire. (8.3)
11. *True or False?* Derating is the reduction in ampacity after calculating adjustment and correction factors. (8.3)
12. The marking is a series of ____ and numbers that reveals key characteristics about a wire. (8.4)
    A. letters
    B. words
    C. trademarks
    D. All are correct.

Apply and Analyze

1. Determine the voltage drop of 100' of 12 AWG copper conductors carrying 20 A. (8.3)
2. List the three factors that affect the ampacity of a conductor. (8.3)

Critical Thinking

1. While both copper and aluminum are used in residential wiring, copper is used more often. However, copper costs more than aluminum. Why, then, do you think copper is used more often than aluminum? (8.2)
2. What size UF wire is needed to feed a 100 A service subpanel installed in a detached garage? Assume the garage temperature will reach 90°F during the summer. (8.3)

Know the Code

A copy of the NEC 2026 is required to answer these questions.

1. What is the correction factor of a THHN wire in conduit running through an attic with a maximum ambient temperature of 150°F?
2. What type of conductors are referred to in *Section 310.16*?
3. What is the title of *Section 310.21*?
4. List three types of conductors as defined in *Article 100*.

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Illustrations

Illustrations have been designed to clearly and simply communicate the specific topic.

End-of-Chapter Content

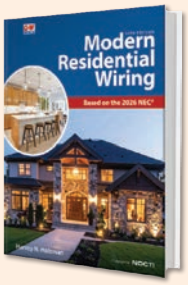
End-of-chapter material provides an opportunity for review and application of concepts. A concise **Summary** provides an additional review tool and reinforces key learning outcomes. This helps you focus on important concepts presented in the text. **Know and Understand** questions enable you to demonstrate knowledge, identification, and comprehension of chapter material. **Apply and Analyze** questions extend learning and develop your abilities to use learned material in new situations and to break down material into its component parts. **Critical Thinking** questions develop higher-order thinking and problem solving abilities. **Internet Resources** list websites that provide content related to the electrical wiring profession. **Know the Code** questions get you familiar with using the *National Electrical Code*.

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TOOLS FOR STUDENT AND INSTRUCTOR SUCCESS

Student Tools

Student Text



Available in print and digital, *Modern Residential Wiring* is a comprehensive text that focuses on safety, electrical theory, tools, and electrical systems, as well as specialized installations, such as swimming pools and emergency standby systems.

Workbook

- Minds-on practice with questions and activities.
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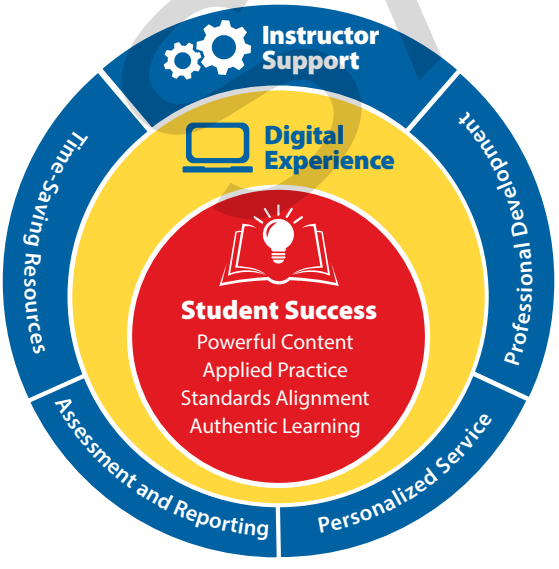
Online Instructor Resources

- Tap into time-saving preparation tools: answer keys, editable lesson plans, and other teaching aids.
- Take advantage of Instructor's Presentations for PowerPoint® with fully customizable, richly illustrated slides that help you teach and visually reinforce the key concepts from each chapter.
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