Preface

Modern Metalworking emphasizes the important role metals play in our everyday lives and explores numerous metalworking career opportunities. This textbook is designed to provide broad exposure to metalworking through the use of materials, tools, machines, and technologies that are fundamental to this important area of industry. Both hand- and machine-tool operations are covered, as well as information on industrial equipment and processes.

Metal is used for many different everyday purposes, such as:

- The manufacture of jet and rocket engines, where the material must withstand tremendous heat.
- The production of mammoth earthmovers, where toughness is a necessity.
- The building of aircraft, where lightweight and indestructible materials are required.
- The manufacture of cars, buses, trucks, and trains for transporting people and goods.
- The creation of devices and technology used in medicine.
- The creation of objects of beauty such as jewelry, tableware, furniture, and works of art.
- The fuel that powers nuclear power plants and oceangoing vessels. Only a few pounds are needed to generate enough power to propel a submarine or aircraft carrier around the world.
- The conversion of sunlight to electrical energy.
- The production of a thin layer of metal, only a microinch (1/1,000,000″) thick, which enables a computer to make split-second computations.

Metals have been used in some way during the production of almost everything we eat, see, feel, hear, smell, and touch. With so much of our daily lives depending upon metals, it is essential that we learn more about them: how they are worked and the industries that use them. With all of this in mind, it is not difficult to answer the question, "Why study metals?"

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About the Author

Kenneth W. Stier completed his bachelor's and master's degrees at the University of Wisconsin–Stout and his doctorate at Illinois State University (ISU). He taught industrial education at the secondary level for six years and taught for 30 years at ISU in the Department of Technology. During his tenure at ISU, Dr. Stier was Coordinator of the Engineering Technology Program and taught courses on manufacturing, machine tool technology, and materials technology. He engaged students in research and project work for a number of industrial companies. Dr. Stier has written numerous refereed journal articles and proceedings, presented at conferences for various professional organizations, and led several accreditation site visitation teams for the Association of Technology, Management, and Applied Engineering (ATMAE). Dr. Stier has received several awards, including the Society of Manufacturing Engineers Sargent Americanism Award and the ATMAE Outstanding Industrial Technology Professor Award for Region 2.

John R. Walker is the author of 13 textbooks and many magazine articles. Mr. Walker did his undergraduate studies at Millersville University and received a master's degree in Industrial Education from the University of Maryland. He taught industrial arts and vocational education for 32 years and was Supervisor of Industrial Education for five years. Mr. Walker also worked as a machinist for the US Air Force and as a draftsman at the US Army Aberdeen Proving Grounds.

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New to This Edition

The twelfth edition of *Modern Metalworking* has been revised to provide coverage of current trends and technologies in the industry and to promote student comprehension of the material. Key updates and improvements include:

- **Organizational Improvements**
  - Arrangement of the content reflects the secondary processes described in Chapter 1, Introduction to Manufacturing, to provide a more logical flow of topics that builds on the foundation of the first chapter.
  - Sections better group chapters according to content, including distinct sections on Drawings, Measurement, and Inspection; Layout Work and Hand Tools; Joining and Assembling; and Conditioning and Finishing.
  - Milling is now covered in two chapters rather than one, making the material less overwhelming and more digestible. Chapter 27 covers Milling Machines, and Chapter 28 covers Manual Horizontal and Vertical Milling Machine Operations.
- **Enhancements to Support Learning**
  - Learning outcomes are numbered, aligned with numbered headings, and tied to summary points and end-of-chapter questions to help with processing and retaining material.
  - End-of-chapter assessments are divided into Know and Understand, Apply and Analyze, and Critical Thinking questions to progress from testing basic knowledge to encouraging higher-order thinking skills.
- **New and Updated Technical Content**
  - **Chapter 1, Introduction to Manufacturing:** Coverage of trends in artificial intelligence and metrology.
  - **Chapter 3, Safety Practices:** Added emphasis on machine operation safety.
  - **Chapter 4, Classifying Metals:** Added coverage of nickel and superalloys.
  - **Chapter 7, Quality Assurance and Inspection:** Now directly follows the chapter on measurement and includes an expanded section on optical comparators to incorporate coverage of digital video comparators.
  - **Chapter 13, Other Metal Casting Techniques:** Updates to coverage of 3D printing in the area of investment casting.
  - **Chapter 14, Powder Metallurgy:** A new section on additive manufacturing with metal powder, as well as new coverage of how metal powders are produced, blending and mixing, isostatic pressing, rolling and extrusion with metal powder, and liquid phase sintering.
  - **Chapter 15, Sheet Metal:** A new section on pattern development using CAD, including new illustrations.
  - **Chapter 16, Metal Spinning:** New material on hot spinning.
  - **Chapter 17, Cutting and Cold Forming Metal Sheet:** A new section on stamping
  - **Chapter 19, Forging:** Added coverage of upset forging.
  - **Chapter 20, Other Wrought Metal Forming Processes:** A new rolling processes section covering flat rolling, shape rolling, ring rolling, and thread rolling, and a new section on drawing processes.
  - **Chapter 32, Soldering, Brazing, and Adhesive Bonding:** Expanded coverage of adhesives and adhesive bonding.
  - **Chapter 35, Other Welding Processes:** Revised to align with the American Welding Society Master Chart of Welding and Allied Processes. An expanded section on gas metal arc welding (GMAC).
- **New photos and illustrations throughout:** Images reflect up-to-date processes and technology.

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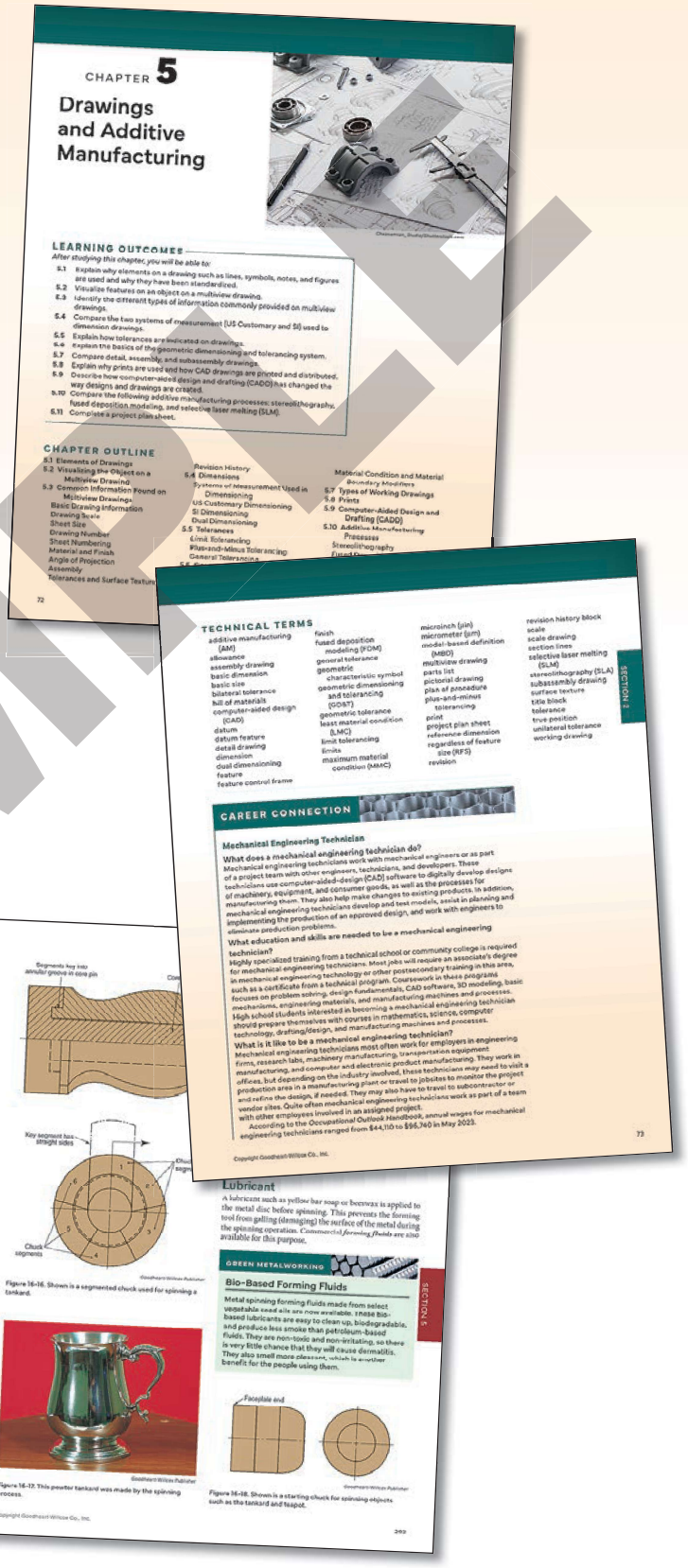
Succeed
Strong Outcomes and a True Partnership

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 list of learning outcomes, a chapter outline, a list of technical terms, and an **Employability** or **Career Connection** feature. 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 help identify topic areas you might need to revisit. **Technical Terms** list the key words to be learned in the chapter. **Employability** features highlight the professional behaviors and traits that employers value. **Career Connection** features provide important information about a wide range of professions related to the metalworking field.


CHAPTER 5
Drawings and Additive Manufacturing
LEARNING OUTCOMES
CHAPTER OUTLINE
TECHNICAL TERMS
CAREER CONNECTION
Mechanical Engineering Technician

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. **Procedures** are highlighted throughout the textbook to provide clear instructions for hands-on activities and processes. **Green Metalworking** features highlight key topics related to sustainability, energy efficiency, and environmental issues.

SAFETY NOTE
PROCEDURE
Positioning a Side Cutter to Mill a Slot in a Flat Surface
Cutting a Keyseat in Round Stock
GREEN METALWORKING
Bio-Based Forming Fluids
Lubricant

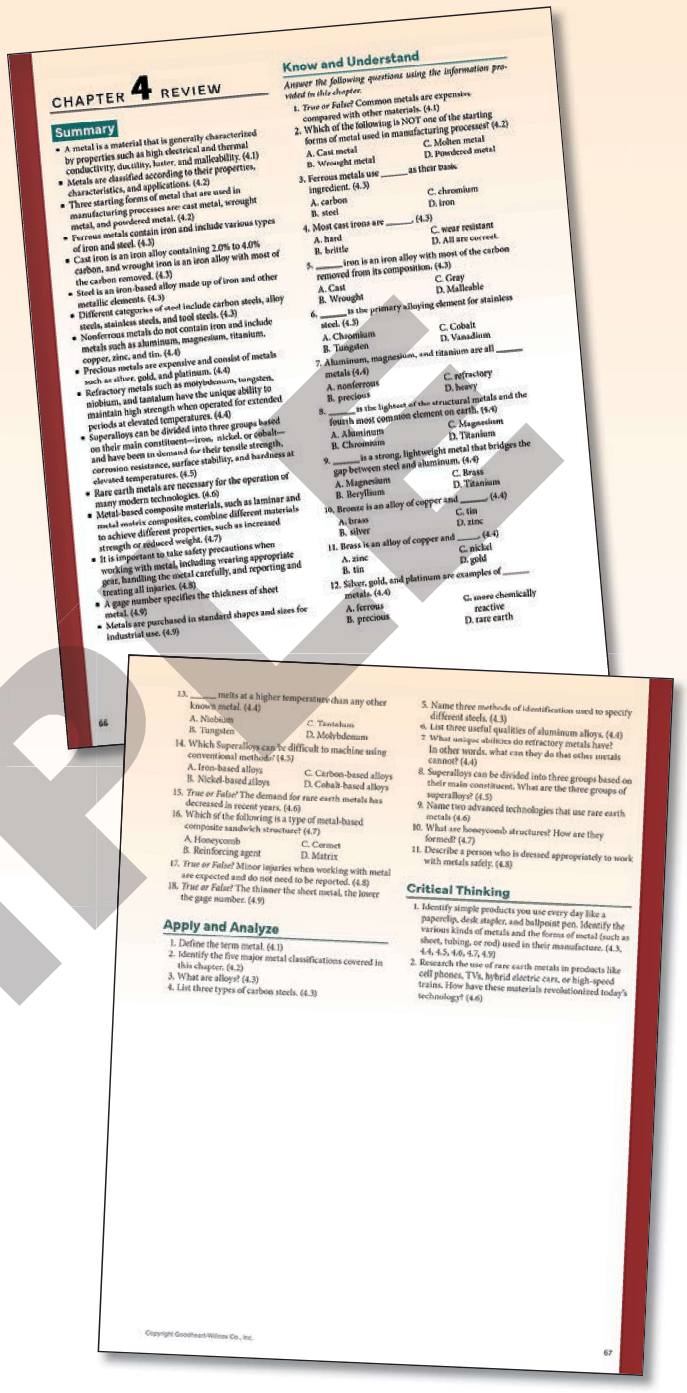
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Illustrations

Illustrations have been designed to clearly and simply communicate the specific topic. Illustrations have been replaced and updated throughout for this edition. Photographic images have been updated to show the latest equipment.

End-of-Chapter Content

End-of-chapter material provides an opportunity for review and application of concepts. A bulleted **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.


CHAPTER 4 REVIEW

Summary

Know and Understand

Apply and Analyze

Critical Thinking

Color Key

A color key is used in illustrations throughout *Modern Metalworking* to indicate various materials or equipment features. The following key shows what each color represents.

- Metals (surfaces)
- Metals (in section)
- Machines/machine parts
- Tools
- Cutting edges
- Rulers and measuring devices
- Fasteners
- Abrasives
- Fluids
- Workholding and toolholding devices

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