

# **AUTOMOTIVE ENGINES**

## **THEORY AND SERVICING**

### **SIXTH EDITION**

**James D. Halderman**



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# PREFACE

## PROFESSIONAL TECHNICIAN SERIES

Part of Prentice Hall Automotive's Professional Technician Series, the sixth edition of *Automotive Engines: Theory and Servicing* presents students and instructors with a practical, real-world approach to automotive technology and service. The series includes textbooks that cover all eight ASE certification test areas of automotive service: Engine Repair (A1), Automotive Transmissions/Transaxles (A2), Manual Drive Trains and Axles (A3), Suspension and Steering (A4), Brakes (A5), Electrical/Electronic Systems (A6), Heating and Air Conditioning (A7), and Engine Performance (A8).

Current revisions are written by the experienced author and peer reviewed by automotive instructors and experts in the field to ensure technical accuracy.

## UPDATES TO THE SIXTH EDITION

The sixth edition has been updated throughout and now has 31 chapters compared to 24 chapters in the fifth edition.

- An expanded chapter on shop safety includes how to safely de-power hybrid electric vehicles (Chapter 1).
- Information on hand tools (Chapter 4) and power tools/shop equipment (Chapter 5) has been expanded and now each is covered in a separate chapter.
- Service information (Chapter 8) and vehicle identification information (Chapter 9) are now in separate chapters to make learning and teaching this material easier.
- Updated chapters on the cooling system (Chapter 13) and the lubrication system (Chapter 14) include many changes in the industry and systems.
- Expanded coverage on automotive fuels now includes all alternative fuels (Chapter 11).
- Expanded coverage on diesel engines includes the new after-treatment devices needed for diesel engines to meet the latest emissions standards (Chapter 12).

- A new chapter on preparation for assembly (Chapter 29) details all of the steps and procedures that are needed to successfully blueprint and assemble an engine.
- There is expanded coverage on variable valve timing and variable displacement engines (Chapter 10).

## ASE AND NATEF CORRELATED

NATEF-certified programs need to demonstrate that they use course materials that cover NATEF and ASE tasks. This textbook has been correlated to the ASE and NATEF task lists and offers comprehensive coverage of all tasks. A [NATEF TASK CORRELATION CHART](#) and an [ASE TEST CORRELATION CHART](#) are located in the appendices to the book.

## A COMPLETE INSTRUCTOR AND STUDENT SUPPLEMENTS PACKAGE

This textbook is accompanied by a full package of instructor and student supplements. See page vi for a detailed list of all supplements available with this book.

## A FOCUS ON DIAGNOSIS AND PROBLEM SOLVING

The Professional Technician series has been developed to satisfy the need for a greater emphasis on problem diagnosis. Automotive instructors and service managers agree that students and beginning technicians need more training in diagnostic procedures and skill development. To meet this need and demonstrate how real-world problems are solved, the "Real World Fix" features are included throughout and highlight how real-life problems are diagnosed and repaired.

The following pages highlight the unique core features that set the Professional Technician series apart from other automotive textbooks.

# IN-TEXT FEATURES

**OBJECTIVES** and **KEY TERMS** appear at the beginning of each chapter to help students and instructors focus on the most important material in each chapter. The chapter objectives are based on specific ASE and NATEF tasks.



**TECH TIP**

**PROFESSIONAL BEHAVIOR IN THE SHOP IS A MUST**

To be respected as a professional service technician and for safety, always behave in a professional manner. These behaviors include, but are not limited to, the following:

- Show respect to other technicians and the shop owner or supervisor. For example, the shop owner or supervisor may not always be right, but they are the boss.
- Avoid horseplay or practical jokes.
- Act as if a customer is observing your times because this is often the case.



**SAFETY TIP**

**COMPRESSED AIR SAFETY**

Improper use of an air nozzle can cause blindness or deafness. Compressed air must be reduced to less than 30 PSI. Figure 1-10. If an air nozzle is used to dry a part, make sure the air stream is directed away from the eyes in the immediate area. Coil and store air hoses when not in use.



**REAL WORLD FIX**

**THE MYSTERIOUS ENGINE VIBRATION**

A Buick-built, 3.8-liter V-6 engine vibrated after a new short block had been installed. The technician who had installed the replacement engine performed the following:

1. Checked the spark plugs
2. Checked the spark plug wires



**FREQUENTLY ASKED QUESTION**

**WHAT GRADE OF GASOLINE DOES THE EPA USE WHEN TESTING ENGINES?**

Due to the various grades and additives used in commercial fuel, the government (EPA) uses a liquid called indolene. Indolene has a research octane number of 96.5 and a motor method octane rating of 88, which results in an R + M ÷ 2 rating of 92.25.

**CHAPTER 1**

**SHOP SAFETY**

**OBJECTIVES**

After studying Chapter 1, the reader will be able to:

- 1. Identify situations where hearing protection should be worn.
- 2. Discuss how to safely handle tools and shop equipment.
- 3. Describe how to properly use a fire extinguisher.
- 4. Discuss shop safety procedures.

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**KEY TERMS**

ANSI (p.2) Bump Cap (p.2) Decibel (dB) (p.3) Eye Wash Station (p.7) Fire Blankets (p.7)	Microbes (p.5) "PASST" (p.6) Personal Protective Equipment (PPE) (p.2) Spontaneous Combustion (p.4)
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**TECH TIPS** feature real-world advice and “tricks of the trade” from ASE-certified master technicians.

**SAFETY TIPS** alert students to possible hazards on the job and how to avoid them.

**REAL WORLD FIXES** present students with actual automotive service scenarios and show how these common (and sometimes uncommon) problems were diagnosed and repaired.

**FREQUENTLY ASKED QUESTIONS** are based on the author’s own experience and provide answers to many of the most common questions asked by students and beginning service technicians.

**NOTES** provide students with additional technical information to give them a greater understanding of a specific task or procedure.

**CAUTIONS** alert students about potential *damage to the vehicle* that can occur during a specific task or service procedure.

**WARNINGS** alert students to potential *harm to the technician* that could occur during a specific task or service procedure.

**NOTE:** The release of only 1 gallon of used oil (a typical oil change) can make a million gallons of fresh water undrinkable.

**CAUTION:** Never use compressed air to blow brake dust. The fine, talc-like brake dust can create a health hazard even if asbestos is not present or is present in dust rather than fiber form.

**WARNING:** Hazardous waste disposal laws include serious penalties for anyone responsible for breaking these laws.



The **SUMMARY, REVIEW QUESTIONS, AND CHAPTER QUIZ** at the end of each chapter help students review the material presented in the chapter and test their mastery of the material.

**STEP-BY-STEP** photo sequences show in detail the steps involved in performing a specific task or service procedure.

**SUMMARY**

- All service technicians should wear safety glasses that meet standard ANSI Z87.1.
- Ear protection should be worn anytime the noise level is at 90 decibels (dB) or higher.
- Safety should be exercised when working with electrical cords or when jump-starting another vehicle.
- If a fire extinguisher is needed, remember: pull the safety pin, aim the nozzle, squeeze the lever, and sweep the nozzle from side-to-side.

**REVIEW QUESTIONS**

- List four items that are personal protective equipment (PPE).
- What are the types of fire extinguishers and their usage?
- What items are included in a typical first-aid box?

**CHAPTER QUIZ**

- What do you call the service technician's protective head cover?
  - Cap
  - Hat
  - Bump cap
  - Helmet
- All safety glasses should meet the standards set by \_\_\_\_\_.
  - ANSI
  - SAE
  - ASE
  - DOT
- When washing hands, the water should be at what temperature?
  - 98°F (37°C)
  - 110°F (43°C)
  - 125°F (52°C)
  - 135°F (57°C)
- Heating protection should be worn anytime the noise level exceeds \_\_\_\_\_.
  - 60 dB
  - 70 dB
  - 80 dB
  - 90 dB
- Two technicians are discussing the safe use of a wrench. Technician A says that a wrench should be pulled toward you. Technician B says that a wrench should be pushed away from you. Which technician is correct?
  - Technician A only
  - Technician B only
  - Both Technicians A and B
  - Neither Technician A nor B
- Exhaust hoses should be used because one of the exhaust gases is deadly in high concentration. This gas is \_\_\_\_\_.
  - Carbon monoxide (CO)
  - Carbon dioxide (CO<sub>2</sub>)
  - Hydrocarbons (HC)
  - Oxides of nitrogen (NO<sub>x</sub>)
- The process of combustion occurring without an open flame is called \_\_\_\_\_.
  - Direct ignition
  - Non-open flame combustion
  - Spontaneous combustion
  - Cold fusion
- When using a fire extinguisher, what word can be used to remember what to do?
  - PASS
  - FIRE
  - RED
  - LEVER

# SUPPLEMENTS

The comprehensive **INSTRUCTOR'S MANUAL** includes chapter outlines, answers to all questions from the book, teaching tips, and additional exercises.

An **INSTRUCTOR'S RESOURCE CD-ROM** features:

- A complete text-specific **TEST BANK WITH TEST CREATION SOFTWARE**
- A comprehensive, text-specific **POWERPOINT PRESENTATION** featuring much of the art from the text as well as video clips and animations
- An **IMAGE LIBRARY** featuring additional images to use for class presentations
- Additional student activities including **CROSSWORD PUZZLES, WORD SEARCHES**, and other worksheets
- A **SAMPLE ASE TEST** as well as the complete **ASE TASK LIST**

To access supplementary materials online, instructors need to request an instructor access code. Go to [www.pearsonhighered.com/irc](http://www.pearsonhighered.com/irc), where you can register for an instructor

access code. Within 48 hours after registering, you will receive a confirming e-mail, including an instructor access code. Once you have received your code, go to the site and log on for full instructions on downloading the materials you wish to use.

Available to be packaged with the book, the **STUDENT WORKTEXT** (NATEF CORRELATED TASK SHEETS), includes 100% of the job sheets tied to specific (A1) Engine Repair NATEF tasks. Contact your local Prentice Hall representative for information on ordering the textbook packaged with the student worktext.

Included with every copy of the book, access to the following website: [www.pearsoned.com/autostudent](http://www.pearsoned.com/autostudent). This resource contains powerpoint presentations, crossword puzzles, word searches, a NATEF task checklist, a sample ASE test, and the complete ASE task list.

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