

**PROFESSIONAL
TECHNICIAN**

FIFTH EDITION

AUTOMOTIVE HEATING AND AIR CONDITIONING



TOM BIRCH

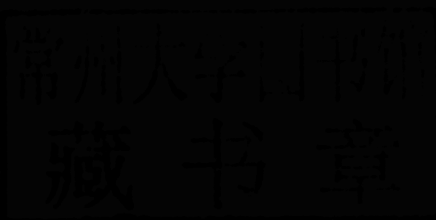


**PEARSON
AUTOMOTIVE**

AUTOMOTIVE HEATING AND AIR CONDITIONING

FIFTH EDITION

Tom Birch



Prentice Hall

Upper Saddle River, New Jersey
Columbus, Ohio

Library of Congress Cataloging-in-Publication Data

Birch, Thomas W. (Thomas Wesley), 1933-
Automotive heating and air conditioning / Tom Birch.—5th ed.
p. cm.
Includes bibliographical references and index.
ISBN 0-13-505136-3 (alk. paper)
1. Automobiles—Heating and ventilation. 2. Automobiles—Air conditioning. I. Title.

TL271.B57 2008
629.2772—dc22

2008042020

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Cover and chapter opener photo: iStockphoto
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This book was set in Weidmann by S4Carlisle and was printed and bound by Edwards Brothers. The cover was printed by Lehigh-Phoenix Color.

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Prentice Hall
is an imprint of

PEARSON

www.pearsonhighered.com

10 9 8 7 6 5 4 3 2
ISBN-13: 978-0-13-505136-8
ISBN-10: 0-13-505136-3

PREFACE

PROFESSIONAL TECHNICIAN SERIES

Part of Prentice Hall Automotive's Professional Technician Series, the fifth edition of *Automotive Heating and Air Conditioning* 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), Automatic Transmissions and Transaxles (A2), Manual Drivetrains and Axles (A3), Steering and Suspension (A4), Brakes (A5), Electrical/Electronic Systems (A6), Heating and Air Conditioning (A7), and Engine Performance (A8). Current revised editions are written by experienced authors and peer reviewed by automotive instructors and experts in the field to ensure technical accuracy.

UPDATES TO THE FIFTH EDITION

- All content is correlated to 100% of the ASE and NATEF tasks for the Heating and Air Conditioning (A7) content area.
- New material describing hybrid vehicle A/C operation, service procedures, and cautions is included.
- New material on heated and climate-controlled seats has been added.
- Many new photographs and line drawings help students understand the content material and bring the subject alive.
- Expanded content describing new SAE J-standards is included.
- Expanded content describing antifreezes and coolants has been added.
- Each technical topic is discussed in one place or chapter. Unlike other textbooks, this book is written so that the theory, construction, diagnosis, and service of a particular component or system are presented in one textbook.

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** is located in the appendix of the accompanying worktext, now called NATEF Correlated Task Sheets.

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" and the "Real World Problem" features in this textbook 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 books 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.



Some experts emphasize that the best way to remove water from a system is to replace the desiccant (accumulator or receiver-drier), as it moves the noncondensable

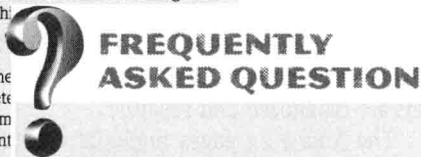


UV rays are harmful to your eyes. Do not look into the lamp. The special yellow goggles will also help protect rays.



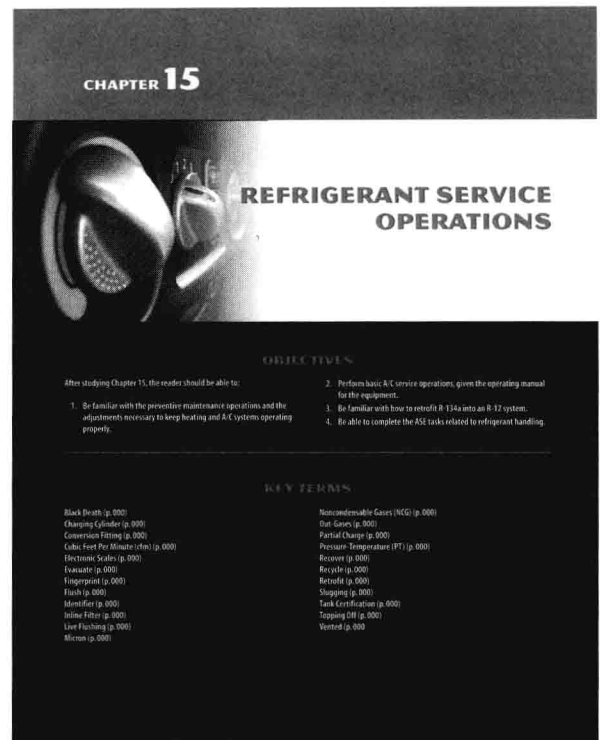
The 2000 Cadillac Deville (41,000 miles) with dual comfort control had a problem of warm air coming from the driver's side outlet when the passenger side. Scan tool faults.

Following advice, the refrigerant charge, and detector were undercharged. The system was recharged with the specified amount of refrigerant.



The word *gauge* means "measurement or dimension to a standard of reference." The word *gauge* can also be spelled *gage*. Therefore, in most cases, the words mean the same.

NOTE: One vehicle manufacturing representative mentioned that *gage* was used rather than *gauge* because even though it is the second acceptable spelling of the word, it is correct and it saved the company a lot of money in printing costs because the word *gage* has one less letter! One letter multiplied by the millions of times that *gage* is used in service manuals adds up to a big savings for the manufacturer.



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 AND PROBLEMS 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 dangers to themselves during a specific task or service procedure.

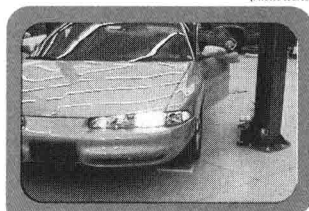
NOTE: Removing the ignition key will shut off the HV system. It is recommended to place the key in your pocket or tool box to prevent someone from putting it back in the ignition switch. *Smart keys* must be disabled before working on the vehicle.

CAUTION: Eyes and skin should always be protected when you are performing operations during which refrigerant might escape.

WARNING Some vehicles with electronic fuel injection have a fuel pressure test port that uses a 1/4-inch flare fitting, the same as an R-12 service port. Make sure that the refrigerant recovery unit is connected into the A/C system and not the fuel system.

HOISTING A VEHICLE Step-by-Step

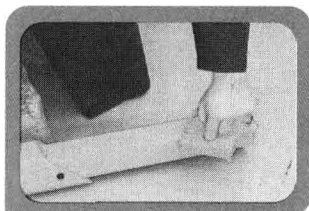
(Photos courtesy of James Halderman)



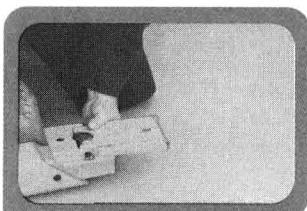
STEP 1 The first step in hoisting a vehicle is to center the vehicle on the hoist.



STEP 2 Most vehicles will be correctly positioned when the left front tire is centered on the tire pad.



STEP 3 Many pads at the end of the hoist arms can be rotated to allow for many different types of vehicles.



STEP 4 The arms of the lifts can be retracted or extended to accommodate vehicles of different lengths and widths.

The **SUMMARY**, **REVIEW QUESTIONS**, and **CHAPTER QUIZ** at the end of Chapters 1 to 18 help students review the material presented in the chapter and test themselves to see how much they've learned.

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

SUMMARY

1. A major maintenance operation is to ensure the system has a good accessory drive belt that is properly adjusted.
2. The first refrigerant service operation is to identify the refrigerant in the system and check to make sure that it does not contain a coolant.
3. The refrigerant is recovered from a system so that service operations can be performed.
4. A Recycle Guard filter can remove contaminants from refrigerant being recovered.
5. Recycling removes foreign particles, water, and air from refrigerant.
6. Sections of an A/C system can be flushed or a filter can be installed to remove foreign particles.

REVIEW QUESTIONS

The following questions are provided to help you study as you read the chapter.

1. A dirty condenser with debris at the front can be cleaned using _____ (or both).
2. The first step in any refrigerant service procedure should be to _____ what type of _____ it is in the system.
3. More than _____ air in the refrigerant of an A/C system is considered contaminated.
4. Refrigerant concentrated with air should be _____ and then _____.

CHAPTER QUIZ

The following questions will help you check the facts you have learned. Select the answer that completes each statement correctly.

1. Student A says that eye protection should be worn when working with refrigerants. Student B says to avoid skin contact with refrigerants and their oil. Who is correct?
 - a. A only
 - b. B only
 - c. Both A and B
 - d. Neither A nor B
2. Two students are discussing how to remove refrigerant from a system. Student A says that you can vent it into the atmosphere as long as it has moisture in it. Student B says that all refrigerant must be captured. Who is correct?
 - a. A only
 - b. B only
 - c. Both A and B

SUPPLEMENTS

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

Included with every copy of the book is access to the following website: **www.pearsonhighered.com/autostudent**. This resource contains:

- 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, 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 WORK-TEXT (NATEF CORRELATED TASK SHEETS)**, includes 100% of the job sheets tied to the Automotive Heating and Air Conditioning (A7) NATEF tasks. Contact your local Prentice Hall representative for information on ordering the textbook packaged with the student worktext.

ACKNOWLEDGMENTS

A large number of people and organizations have cooperated in providing the reference material and technical information used in this text. The author wishes to express sincere thanks to the following organizations for their special contributions:

ACDelco
 Acme Radiator & Air Conditioning
 Airsept, Inc.
 American Lokring Corporation
 Appollo America Corporation, Lorie Homolish
 Bill Steen, Yuba College
 BLR Enterprises
 Bright Solutions
 John Brunner
 Castrol North America
 Cliplight Manufacturing Company
 DaimlerChrysler Corporation
 David Brainerd, Santa Barbara City College
 Dayco Products, Inc.
 Delphi Corporation
 Environmental Test Systems, Inc.
 The Ergonomics Society
 Everco Industries
 Fedco Automotive Components, Patrick L. O'Conner
 Four Seasons
 The Gates Rubber Company
 General Motors Corporation
 Goodyear Tire & Rubber Company
 INFICON
 International Mobile Air Conditioning Association
 (IMACA), Executive Director, Frank Allison
 James Halderman
 James Johnson, Four Seasons
 John Fluke Mfg. Co.
 Kent-Moore
 Lisle Corporation
 Mastercool
 Mobile Air Conditioning Society (MACS), Paul
 De Guiseppi
 Mobile Air Conditioning Society (MACS), Simon
 Oulouhojian, Past President
 Modine Manufacturing

Nartron Corp./Smart Power Products
 Neutronics Inc.
 Nissan Motor Corporation
 Purdue University, Frederick Peacock
 Raytek Corp.
 Red Dot Corp.
 Robinaire Division, SPX Corporation
 Sanden International (USA)
 Santech Industries
 Saturn Corporation
 Selective Technology, Seltec
 Sercon Spectronics Corporation
 Snap-on Tools Company
 Society of Automotive Engineers (SAE)
 Stant Manufacturing
 System Guard
 TDR Stabilizer Clamp Company
 Technical Chemical Company (TCC)
 TIF Instruments
 Tony Jewel, Reedley College
 Toyota Motor Corporation
 Tracer Products
 UView Ultraviolet Systems
 Visteon Corporation
 Waekon Industries
 Warner Electric
 White Industries
 Wynn Oil Company
 Yokogawa Corporation of America
 Zexel Illinois

Portions of materials contained herein have been reprinted with permission of General Motors Corporation, Service Operations.

Finally, I would like to thank the following reviewers for their helpful suggestions: Mark Durivage, Owens Community College; John Eichelberger, St. Philip's College; and Mitchell Walker, St. Louis Community College.

Tom Birch

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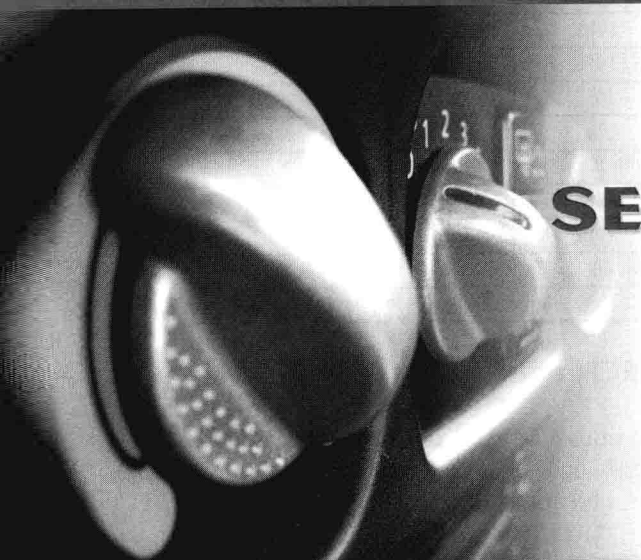
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CHAPTER 1



SERVICE INFORMATION, FASTENERS, TOOLS, AND SAFETY

OBJECTIVES

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

1. Retrieve vehicle service information.
2. Identify the strength ratings of threaded fasteners.
3. Know how to safely use hand tools.
4. Describe how to safely hoist a vehicle.
5. Identify the personal safety equipment that all service technicians should wear.
6. Understand the ASE requirements for vehicle identification and the proper use of tools and shop equipment.

KEY TERMS

- | | |
|---|---|
| Aftermarket (p. 3) | Special Service Tools (SSTs) (p. 11) |
| Barrel (p. 12) | Spindle (p. 12) |
| Bolt (p. 5) | Spontaneous Combustion (p. 16) |
| Bump Cap (p. 14) | Stud (p. 5) |
| Cap Screw (p. 5) | Technical Service Bulletins (TSBs) (p. 4) |
| Dial Indicator (p. 13) | Telescopic Gauge (p. 12) |
| Grade (p. 6) | Thimble (p. 12) |
| International Automotive Technicians' Network (IATN) (p. 4) | Unified National Coarse (UNC) (p. 5) |
| Lock Washer (p. 7) | Unified National Fine (UNF) (p. 5) |
| Loctite (p. 7) | Vehicle Emissions Control Information (VECI) (p. 2) |
| Micrometer (p. 12) | Vehicle Identification Number (VIN) (p. 2) |
| Nut (p. 6) | Vernier or Dial Caliper (p. 13) |
| OEM (p. 3) | Washer (p. 7) |
| Pitch (p. 5) | |

1.1 VEHICLE IDENTIFICATION

All service work requires the vehicle and its components to be properly identified. The most common identification method is verifying the make, model, and year of the vehicle.

Make: e.g., Chevrolet

Model: e.g., Trailblazer

Year: e.g., 2003

The year of the vehicle is often difficult to determine exactly. Typically, a new model year starts in September or October of the year prior to the actual new year, but not always. A model may be introduced as the next year's model as soon as January of the previous year. This is why the **vehicle identification number**, usually abbreviated **VIN**, is so important (Figure 1-1). Since 1981 all vehicle manufacturers have used a VIN that is 17 characters long. Although every vehicle manufacturer assigns various letters or numbers within these 17 characters, there are some constants, including:

- The first number or letter designates the country of origin.

1 = United States	K = Korea
2 = Canada	L = Taiwan
3 = Mexico	S = England
4 = United States	V = France
6 = Australia	W = Germany
9 = Brazil	Y = Sweden
J = Japan	Z = Italy

- The model of the vehicle is commonly the fourth or fifth character.
- The eighth character is often the engine code. (Some engines cannot be determined by the VIN.)

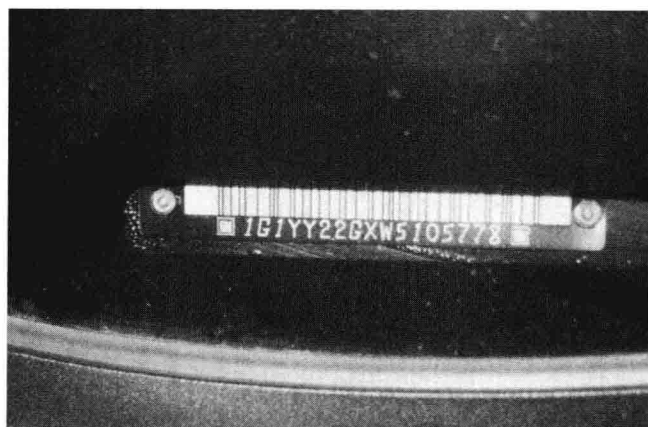


FIGURE 1-1 The vehicle identification number (VIN) is at the top front of the instrument panel and is visible through the windshield. (Courtesy of James Halderman)

- The tenth character represents the year on all vehicles.

A = 1980	L = 1990	Y = 2000
B = 1981	M = 1991	1 = 2001
C = 1982	N = 1992	2 = 2002
D = 1983	P = 1993	3 = 2003
E = 1984	R = 1994	4 = 2004
F = 1985	S = 1995	5 = 2005
G = 1986	T = 1996	6 = 2006
H = 1987	V = 1997	7 = 2007
J = 1988	W = 1998	8 = 2008
K = 1989	X = 1999	9 = 2009

1.1.1 VECI Label

The **vehicle emissions control information (VECI)** label located under the hood of the vehicle shows informative settings and emission hose routing information (Figure 1-2). The VECI label (sticker) can be located on the underside of the hood, the radiator fan shroud, radiator core support, or on the strut towers. The VECI label usually includes the following information:

- Engine identification
- Emission control information
- Vacuum hose routing diagram
- Base ignition timing (if adjustable)
- Spark plug type and gap
- Valve lash
- Emission calibration code

1.1.2 Calibration Codes

Calibration codes are usually located on power train control modules (PCMs) or other controllers. Whenever diagnosing

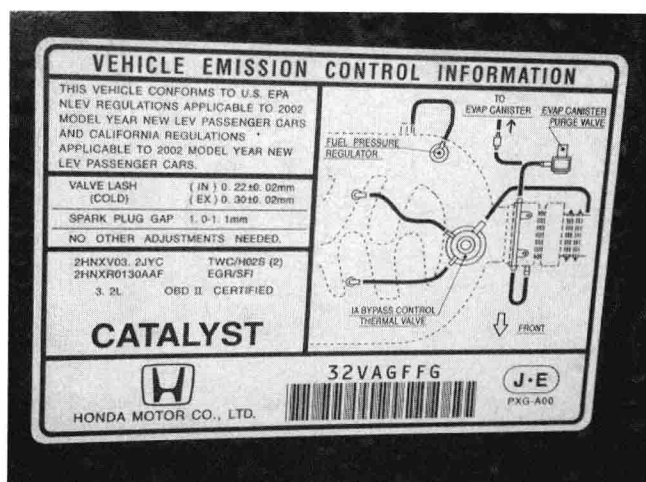


FIGURE 1-2 The VECI, vehicle emission control information, label is attached to an underhood portion of the vehicle.