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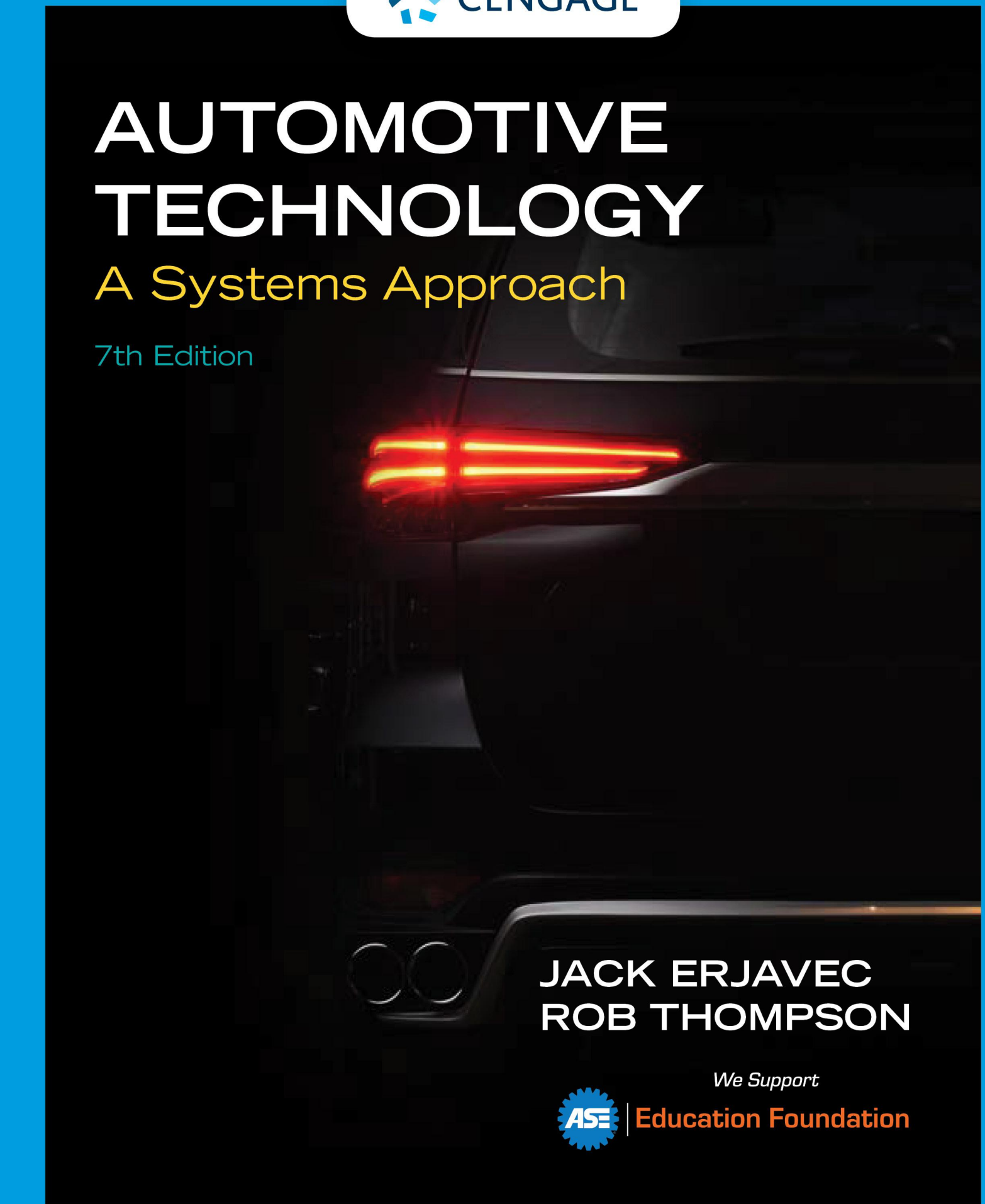
AUTOMOTIVE TECHNOLOGY

A Systems Approach

7th Edition



JACK ERJAVEC
ROB THOMPSON

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AUTOMOTIVE TECHNOLOGY

A Systems Approach

7th Edition

Jack Erjavec

Rob Thompson

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***Automotive Technology: A Systems Approach*, 7th Edition**
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PREFACE

About the Book

Manufacturers have made major and constant changes to the various systems of an automobile, and the integration and codependence of those systems have made becoming a successful technician more challenging than ever. This book, *Automotive Technology: A Systems Approach*, was designed and written to prepare students for those challenges. The basic premise is "with students having so much to learn in a short time, why fill the pages of a textbook with information they do not need?" The emphasis of this book is on those things that students need to know about the vehicles of today and tomorrow.

This does not mean that the pages are filled with fact after fact. Rather, each topic is explained in a logical way, slowly but surely. With more than 45 years of combined teaching experience, we believe we have a good sense of how students read and understand technical material. We also know what things draw their interest into a topic and keep it there. These things have been incorporated in the writing and features of the book.

This new edition of *Automotive Technology: A Systems Approach* represents the many changes that have taken place in the automotive industry over the past few years. With each new edition, the challenge of what to include and what to delete presents itself. We hope that we have made the right choices. of course, if we did, much of the credit is due to the feedback we have received from users of the previous edition and those who reviewed this new edition while it was in the making. They all did a fantastic job and showed that they are truly dedicated to automotive education.

New to this Edition

This seventh edition is not the sixth edition with a new cover and some new pictures. Although much of the information from the previous edition was retained, each chapter has been updated in response to the changing industry. In addition, there are some new features that should be helpful to students and their instructors. We have made sure that all of the latest ASE program standards are covered in this text. Regardless of the level of program accreditation, you will find the appropriate information in this book.

The first section of chapters gives an overview of the automotive industry, careers, working as a technician, tools, diagnostic equipment, and basic automotive systems. The content of these chapters has been updated and arranged to prepare students for the responsibilities and demands of a career as an automotive technician.

Chapter 1 explores the career opportunities in the automotive industry. This discussion has been expanded to include more information about ASE certification and testing. Chapter 2 covers workplace skills and the ways to go about seeking and selecting a job in the automotive field. This chapter goes through the process of getting a job and keeping it. It also covers some of the duties common to all automotive technicians. This chapter has been updated to include online resources.

Chapter 3 covers the science and math principles that are the basis for the operating principles of an automobile. Too often, we, as instructors assume that our students know these basics. This chapter is included to serve as a reference for those students who want to be good technicians. To do that they need a better understanding of why things happen the way they do.

Chapter 4 covers the basic systems of the automobile in a very basic approach and has been updated to include hybrid vehicles and alternative fuels. Chapters 5 through 7 cover very important issues regarding the use and care of hand tools, shop equipment, and safety issues (including bloodborne pathogens). Throughout these chapters, there is a strong emphasis on safely working on today's vehicles and the correct tools required to do so. Chapter 6 gives a brief look at the special and diagnostic tools required for working in each of the eight primary ASE certification areas. The tools discussed include all of the required tools for each area as defined by the ASE Education Foundation (formerly NATEF).

Chapter 8 covers the procedures involved in common safety inspections and preventive maintenance programs. Because the industry has more hybrid

vehicles than in previous years, basic maintenance for those vehicles has been included.

Section 2, which contains the chapters on engines, has been updated to include more coverage on the latest engine designs and technologies. There is more coverage on the theory, diagnosis, and service to alloy engines and overhead camshaft engines. There are also discussions on the latest trends, including variable valve timing and lift and cylinder disabling systems. A discussion of light-duty diesel engines and those engines used in hybrid vehicles is also part of the entire section.

It is nearly impossible to work on modern cars and trucks without a solid understanding of basic electricity and electronics as contained in Section 3. As a result, little has been deleted from those chapters while new information has been added to keep up with current technology. Coverage of all the major electrical systems has been increased to include new technologies. This includes high-voltage systems, new exterior lighting systems, adaptive systems (such as cruise control), semi-autonomous and autonomous driving technologies, and many new accessories. The rest of the section has been brought up to date with additional coverage on body computers and the use of lab scopes and graphing meters.

The entire Engine Performance section (Section 4) has been updated from the introductory chapters to those that deal with overall engine performance testing. The layout represents the approach taken by most experienced technicians. It is hoped that students will be able to grasp a global look at these systems and can become better diagnosticians. The revision of the section covers the individual engine performance systems, their operation, and how to test them with current diagnostic equipment. Added emphasis on diagnostics was the main goal of the revision of the rest of this section.

Included in this section are three chapters that deal with some of the dynamic aspects of the automotive industry. Chapter 28 is dedicated to gasoline, diesel, and other fuels. It also covers the operation and service of light-duty diesel engines, including their injection and emission control systems. Due to the increasing number of hybrid and electric vehicles on the road, this edition has an entire chapter dedicated to hybrid vehicles in addition to the information that appears in various chapters. Chapter 36 focuses on currently available electric and fuel cell vehicles.

Sections 5 and 6 cover transmissions and drivelines. All of the chapters in these sections have been updated to include more coverage on electronic controls. There is also more coverage on six-, seven-, and eight and ten-speed transmissions, automatic manual transmissions, new differential designs, and electronic automatic transmissions and transaxles. In addition, there is complete coverage on the transmissions used in today's hybrid vehicles. There is a comprehensive look at torque vectoring systems, which are becoming more common on all types of vehicles.

The suspension and steering systems section has increased coverage on electronic controls and systems. This includes the new designs of shock absorbers and four-wheel steering systems. Chapter 49 has been updated to include the latest techniques for performing a four-wheel alignment.

The Brakes section has also been updated to reflect current technology. This includes the latest antilock brake, stability control, and traction control systems.

Heating and air-conditioning systems are covered in Section 9. The content in Chapters 54 and 55 includes hybrid systems, R-1234yf components and service, as well as future refrigerants.

Organization and Goals of this Edition

This edition is still a comprehensive guide to the service and repair of our contemporary automobiles. It is still divided into nine sections that relate to the specific automotive systems. The chapters within each section describe the various subsystems and individual components. Diagnostic and service procedures that are unique to different automobile manufacturers also are included in these chapters. Because many automotive systems are integrated, the chapters explain these important relationships in great detail. It is important to note that all of latest ASE Education Alliance standards are addressed in this edition.

Effective diagnostic skills begin with learning to isolate the problem. The exact cause is easier to pinpoint by identifying the system that contains the problem. Learning to think logically about troubleshooting problems is crucial to mastering this essential skill. Therefore, logical troubleshooting techniques are discussed throughout this text. Each chapter describes ways to isolate the problem system and then the individual components of that system.

This *systems approach* gives the student important preparation opportunities for the ASE certification exams. These exams are categorized by the automobile's major systems. The book's sections are outlined to match the ASE test specifications and competency task lists. The review questions at the end of every chapter give students practice in answering ASE-style review questions.

More importantly, a *systems approach* allows students to have a better understanding of the total vehicle. With this understanding, they have a good chance for a successful career as an automotive technician. That is the single most important goal of this text.

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About the Author

Jack Erjavec has become a fixture in the automotive textbook publishing world. He has many years of experience as a technician, educator, author, and editor and has authored or coauthored more than forty automotive textbooks and training manuals. Mr. Erjavec holds a Master of Arts degree in Vocational and Technical Education from Ohio State University. He spent 20 years at Columbus State Community College as an instructor and administrator and has also been a long-time affiliate of the North American Council of Automotive Teachers, including serving on the board of directors and as executive vice-president. Jack was also associated with ATMC, SAE, ASA, ATRA, AERA, and other automotive professional associations.

Rob Thompson started his teaching career as an adjunct faculty member at Columbus State Community College while still working full-time as a technician. Since 1995, he has taught the high school automotive technology program that he himself graduated from a long time ago. Rob has an associate of applied science degree in automotive technology, has been a board member and is a past-president of the North American Council of Automotive Teachers (NACAT). Rob has ASE Master and Advanced Level Technician certifications.

FEATURES OF THE TEXT

Learning how to maintain and repair today's automobiles can be a daunting endeavor. To guide the readers through this complex material, we have built in a series of features that will ease the teaching and learning processes.

Objectives

Each chapter begins with the purpose of the chapter, stated in a list of objectives. Both cognitive and performance objectives are included in the lists. The objectives state the expected outcome that will result from completing a thorough study of the contents in the chapters.

The Three Cs

New in the previous edition and updated for this edition is the feature called *The Three Cs*. The Three Cs, meaning the *concern, cause, and correction*, are used to help technicians identify the concern or customer complaint, the underlying reason or cause of the concern, and how to correct the problem. The chapter openers in Sections 2 through 9 each contain a Three Cs scenario where the reader is presented with a shortened repair order (RO) and customer concern. Within the chapter, information regarding the concern's possible causes and corrections are provided. Finally, at the end of the chapter, the cause and correction to the scenario are presented to the reader, with rationale notes about any special considerations regarding the diagnosis and repair. In many of The Three Cs scenarios, the details are taken from real-world situations. We hope this feature will be useful in providing a real-world look at how vehicles are presented to technicians and how customer concerns are resolved.

Cautions and Warnings

Instructors often tell us that shop safety is their most important concern. Cautions and warnings appear frequently in every chapter to alert students to important safety concerns.

Shop Talk

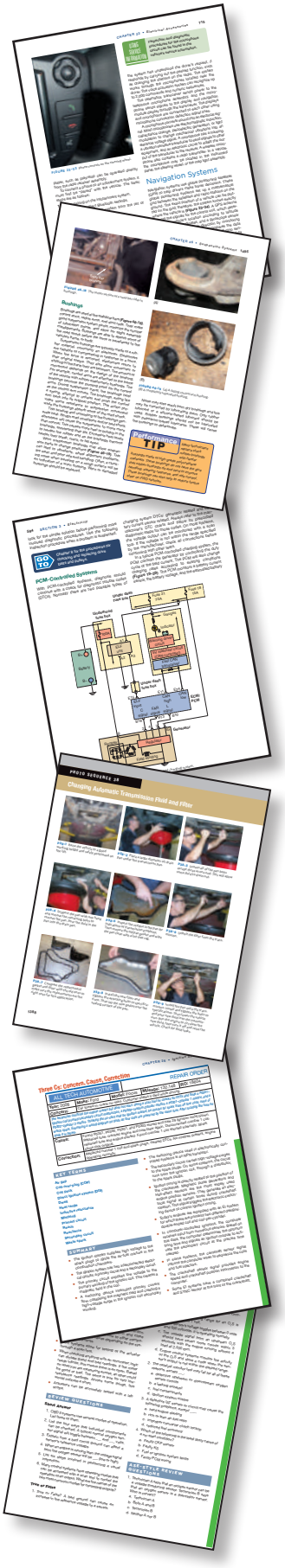
These features are sprinkled throughout each chapter to give practical, commonsense advice on service and maintenance procedures.

Customer Care

Creating a professional image is an important part of shaping a successful career in automotive technology. The customer care tips were written to encourage professional integrity. They give advice on educating customers and keeping them satisfied.

Tool Care

The Tool Care feature discusses proper use and care of common tools so that they can remain functioning and usable for years to come.



Using Service Information

Learning to use available service information is critical to becoming a successful technician. The source of information varies from printed material to online materials. The gathering of information can be a time-consuming task but nonetheless is extremely important. We have included a feature that points the student in the right direction to find the right information.

Performance Tips

This feature introduces students to the ideas and theories behind many performance-enhancing techniques used by professionals.

"Go To" Feature

This feature is used throughout the chapters and tells the student where to go in the text for prerequisite and additional information on the topic.

Photo Sequences

Step-by-step photo sequences illustrate practical shop techniques. The photo sequences focus on techniques that are common, need-to-know service and maintenance procedures. These photo sequences give students a clean, detailed image of what to look for when they perform these procedures. This was a popular feature of the previous editions, so we now have a total of 51.

Procedures

This feature gives detailed, step-by-step instructions for important service and maintenance procedures. These hands-on procedures appear frequently and are given in great detail because they help to develop good shop skills and help to meet competencies required for ASE certification.

Key Terms

Each chapter ends with a list of the terms that were introduced in the chapter. These terms are highlighted in the text when they are first used, and many are defined in the glossary.

Summary

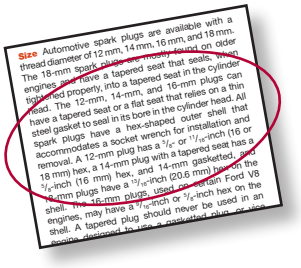
Highlights and key bits of information from the chapter are listed at the end of each chapter. This listing is designed to serve as a refresher for the reader.

Review Questions

A combination of short-answer essay, true or false, and multiple-choice questions make up the end-of-chapter review questions. Different question types are used to challenge the reader's understanding of the chapter's contents. The chapter objectives are used as the basis for the review questions.

ASE-Style Review Questions

In any chapter that relates to one of the ASE certification areas, there are ten ASE-style review questions that relate to that area. Some are quite challenging and others are a simple review of the contents of the chapter.



Metric Equivalents

Throughout the text, all measurements are given in UCS and metric increments.

Supplements

The Automotive Technology package offers a full complement of supplements:

Tech Manual

The Tech Manual offers students opportunities to strengthen their comprehension of key concepts and to develop their hands-on, practical shop experience. Each chapter includes Concept Activities and Job Sheets, which are directly correlated to ASE Education Foundation tasks. Service information report sheets and review questions are also included to offer a rounded approach to each lesson.

Instructor Resources

The Instructor Resources (on CD and companion website) for the seventh edition include the following components to help minimize instructor prep time and engage students:

- **PowerPoint**—Chapter outlines with images, animations, and video clips for each textbook chapter.
- **Computerized Test Bank in Cognero**—Hundreds of modifiable questions for exams, quizzes, in-class work, or homework assignments in an online platform.
- **Image Gallery**—Access to hundreds of images from the textbook that can be used to easily customize the PowerPoint outlines.
- **Photo Sequences**—Each of the Photo Sequences from the textbook are provided within PowerPoint for easy classroom projection.
- **End-of-Chapter Review Questions**—Word files of all textbook review questions are provided for easy distribution to students.
- **Instructor's Manual**—An electronic version of the Instructor's Manual provides lecture outlines with teaching hints, answers to review questions from the textbook, and answers to *Tech Manual* questions, as well as guidelines for using the *Tech Manual*. A correlation chart to the current ASE Education Foundation Standards provides references to topic coverage in both the text and *Tech Manual*.
- **ASE Education Foundation Correlations**—The current ASE Education Foundation Automobile Standards are correlated to the chapter and page numbers of the core text and all relevant *Tech Manual* job sheets.
- **Job Sheet Template**—For instructors who develop their own job sheets, a template is provided to help with their formatting.

Mindtap for Automotive

MindTap is a personalized teaching experience with relevant assignments that guide students to analyze, apply, and improve thinking, allowing you to measure skills and outcomes with ease.

- *Personalized Teaching:* Becomes YOURS with a Learning Path that is built with key student objectives. Control what students see and when they see it—match your syllabus exactly by hiding, rearranging, or adding you own content.
- *Guide Students:* Goes beyond the traditional "lift and shift" model by creating a unique learning path of relevant readings, multimedia, and activities that move students up the learning taxonomy from basic knowledge and comprehension to analysis and application.
- *Measure Skills and Outcomes:* Analytics and reports provide a snapshot of class progress, time on task, engagement and completion rates.

CHAPTER 1

CAREERS IN THE AUTOMOTIVE INDUSTRY

OBJECTIVES

- Describe the various types of jobs available in the automotive industry.
- Explain how computer technology has changed the way vehicles are built and serviced.
- Explain why the need for qualified automotive technicians is increasing.
- Describe the major types of businesses that employ automotive technicians.
- List some of the many job opportunities available to people with a background in automotive technology.
- Describe the different ways a student can gain work experience while attending classes.
- Describe the requirements for ASE certification as an automotive technician and as a master auto technician.

The Automotive Industry

Each year millions of new cars and light trucks are produced and sold in North America **(Figure 1–1)**. The automotive industry's part in the total economy of the United States is second only to the food industry. Manufacturing, selling, and servicing these vehicles are parts of an incredibly large, diverse, and expanding industry.

Forty years ago, America's "big three" automakers—General Motors Corporation, Ford Motor Company, and Chrysler Corporation—dominated the auto industry. This is no longer true. The industry is now a global industry **(Table 1–1)**. Automakers from Japan, Korea, Germany, Sweden, and other European and Asian countries compete with companies in the United States for domestic and foreign sales.

Several foreign manufacturers, such as BMW, Honda, Hyundai, Mercedes-Benz, Nissan, Toyota, and Volkswagen, operate assembly plants in the United States and Canada. Automobile manufacturers have joined together, or merged, to reduce costs and increase market share. In addition, many smaller

FIGURE 1–1 Ford's F-150 pickup has been the best-selling vehicle in America for many years.

auto manufacturers have been bought by larger companies to form large global automobile companies. Most often the ownership of a company is not readily identifiable by the brand name.

This cooperation between manufacturers has given customers an extremely wide selection of vehicles to choose from. This variety has also created new challenges for automotive technicians, based on one simple fact: Along with the different models come different systems.

The Importance of Auto Technicians

The automobile started out as a simple mechanical beast. It moved people and things with little regard to the environment, safety, and comfort.

TABLE 1–1 FACTS ABOUT THE PASSENGER CARS AND LIGHT- AND MEDIUM-DUTY TRUCKS SOLD IN NORTH AMERICA (ALL FIGURES ARE APPROXIMATE).

Manufacturer	Owned by	Common Brands	Country of Origin	Annual Sales
BMW AG	Shareholders 53% and Family 47%	BMW, Mini, and Rolls-Royce	Germany	350 thousand
Chrysler Group	Fiat 59% and UAW 41%	Chrysler, Dodge, and Ram	Italy and North America	2.2 million
Daimler AG	Aabar Investments 8%, Kuwait Investments 7%, Renault-Nissan 3%, and Shareholders 81%	Bentley, Daimler Trucks & Buses, Mercedes-Benz, and Smart	Germany	478 thousand
Fiat S.P.A.	Family 30% and Shareholders 70%	Abarth, Alfa Romeo, Chrysler, Ferrari, Fiat, Lancia, and Maserati	Italy	33 thousand
Ford Motor Company	Family 40% and Shareholders 60%	Ford and Lincoln	North America	2.4 million
Fuji Heavy Ind. Ltd.	Shareholders 81%, Toyota 16%, Suzuki 2%, and Fuji 1%	Subaru	Japan	647 thousand
Geely Automotive	Li Shu Fu 50% and Shareholders 50%	Volvo	China	81 thousand
General Motors	UAW Trust 10%, Canada DIC 9% and Shareholders 81%	Buick, Cadillac, Chevrolet, GMC, and Holden	North America	3 million
Honda Motor Co.	Shareholders 80%, Japan Trustee Bank 8%, and Master Trust Bank of Japan, Moxley & Co., and JP Morgan Chase 4% each	Acura and Honda	North America and Japan	1.5 million
Hyundai Motor Co.	Shareholders 74%, Hyundai Mobis 21%, and Chung Mong-Koo 5%	Hyundai and Kia	Korea	1.3 million

TABLE 1–1 *(continued)*

Manufacturer	Owned by	Common Brands	Country of Origin	Annual Sales
Mazda Motor Corp.	Shareholders 80%, Japan Trustee Bank and Chase Manhattan 5% each, and Master Trust of Japan, Mitori Bank Corp., and Ford Motor Co. 4% each	Mazda	Japan	289 thousand
Mitsubishi Motors	Shareholders 71% and Mitsubishi Corp. 29%		Japan	103 thousand
Nissan Motor Corp.	Shareholders 52%, Renault SA 44%, Nissan 1%, and Daimler 3%	Nissan and Infiniti	Japan	1.6 million
Porsche Auto Holding	Volkswagen AG	Porsche	Germany	55 thousand
Tata Motors	Tata 35%, Indian Banks 14%, and Shareholders 50%	Jaguar, Rover, and Tata	India	128 thousand
Toyota Motor Corp.	Shareholders 85%, Toyota 9%, and Others 6%	Daihatsu, Isuzu, Lexus, Scion, Telsa, and Toyota	Japan	2.4 million
Volkswagen AG	Porsche 54%, Lower Saxony 20%, Qatar Holding 17%, and Shareholders 10%	Audi, Bentley, Bugatti, Lamborghini, and Volkswagen	Germany	500 thousand

Through the years, these concerns have provided the impetus for design changes. One area that has affected automobile design the most is the same area that has greatly influenced the rest of our lives, electronics. Today's automobiles are sophisticated electronically controlled machines. To provide comfort and safety while being friendly to the environment, today's automobiles use the latest developments of many different technologies—mechanical and chemical engineering, hydraulics, refrigeration, pneumatics, physics, and, of course, electronics.

An understanding of electronics is a must for all automotive technicians **(Figure 1–2)**. The needed level of understanding is not that of an engineer; rather, technicians need a practical understanding of electronics. In addition to having the mechanical skills needed to remove, repair, and replace faulty or damaged components, today's technicians also must be able to diagnose and service complex electronic systems.

Computers and electronic devices are used to control the operation of nearly all systems of an automobile. Because of these controls, today's automobiles use less fuel, perform better, and run cleaner than those in the past. The number of electronically controlled systems on cars and trucks increases each year. There are many reasons for the heavy insurgence of electronics into automobiles. Electronics are based on electricity and electricity moves at the speed of light. This means the operation of the various systems can be monitored and changed very quickly. Electronic components have no moving parts, are durable, do not require periodic adjustments, and are very light. Electronics also allow the various systems to work together, which increases the efficiency of each system, and therefore the entire vehicle.

The application of electronics has also led to the success of hybrid and electric vehicles **(Figure 1–3)**. A hybrid vehicle has two separate sources of power. Those power sources can work together to move the vehicle or power the vehicle on their own. Today's hybrid vehicles are moved by electric motors and/or a gasoline engine. Hybrid vehicles are complex machines and all who work on them must be

FIGURE 1–2 An understanding of electronics is a must for all automotive technicians.

properly trained. Advanced electronics has also led to the resurgence of pure electric vehicles, with over 150,000 new electric vehicles sold in the United States in 2016 alone.

The design of today's automobiles is also influenced by legislation. Throughout history, automobile manufacturers have been required to respond to new laws designed to make automobiles safer and cleaner running. In response to these laws, new systems and components are introduced. Anyone desiring to be a good technician and have a successful career must regularly update his or her skills to keep up with the technology.

Legislation has not only influenced the design of gasoline-powered vehicles, it has also led to a wider use of diesel engines in passenger vehicles. By mandating cleaner diesel fuels, the laws have opened the door for clean burning and highly efficient diesel engines. Many states have laws that require owners to have their vehicles exhaust tested on an annual basis. Some states require automobiles to pass an annual or biannual inspection.

FIGURE 1–3 A charging station at a new car dealership.

The Need for Quality Service

The need for good technicians continues to grow. Currently there is a great shortage of qualified automotive technicians. This means there are, and will be, excellent career opportunities for good technicians. Good technicians are able to diagnose and repair problems in today's automobiles **(Figure 1–4)**.

Car owners demand that when things go wrong, they should be "fixed right the first time." The primary reason some technicians are unable to fix a particular problem is simply that they cannot find the cause of the problem. Today's vehicles are complex and a great amount of knowledge and understanding is required for good diagnostic skills. Today's technicians must be able to identify and solve problems the first time the vehicle is brought into the shop.

FIGURE 1–4 Good technicians are able to follow specific manufacturers' diagnostic charts and interpret the results of diagnostic tests.

The Need for Ongoing Service

Electronic controls have not eliminated the need for routine service and scheduled maintenance **(Figure 1–5)**. In fact, they have made it more important than ever. But electronic systems can automatically make adjustments to compensate for some problems, a computer cannot replace worn parts. A computer cannot tighten loose belts or change dirty coolant or engine oil. Simple problems such as these can set off a chain of unwanted events in an engine control system. Electronic controls are designed to help a well-maintained vehicle operate efficiently. They are not designed to repair systems.

Electronic systems are based on the same principles as a computer. In fact, these systems rely on computers to control the operation of a component or system. Instead of a keyboard, automotive electronic systems rely on sensors or inputs. These send information to the computer. The computer receives the inputs and through computer logic causes a component to change the way it is operating. These controlled outputs are similar to your computer screen or printer.

Each automobile manufacturer recommends that certain maintenance services be performed according to a specific schedule. These maintenance procedures are referred to as **preventive maintenance (PM)** because they are designed to prevent problems. Scheduled PM normally includes oil and filter changes; coolant and lubrication services; replacement of belts and hoses; and replacement of spark plugs, filters, and worn electrical parts **(Figure 1–6)**.

If the owner fails to follow the recommended maintenance schedule, the vehicle's warranty might

FIGURE 1–5 Regular preventive maintenance (PM) is important for keeping electronic control systems operating correctly. A common part of PM is changing the engine's oil and filter.

5,000 MILES OR 6 MONTHS

- Replace engine oil and oil filter
- Reset service reminder indicator display
- Rotate tires
- Visually inspect brake linings and fluid level
- Inspect wiper blades
- Check windshield washer fluid level and system
- Check tires and spare wheel for pressure and wear

Additional items for special operating conditions

- Rotate tires and reset TPMS
- Inspect ball joints and dust covers
- Inspect drive shaft boots
- Inspect air filter
- Inspect steering linkage and boots
- Re-torque drive shaft bolt
- Tighten nuts and bolts on chassis

15,000 MILES OR 18 MONTHS

(Same as 5,000 miles and 6 months) ***Plus****:*

- Inspect battery and cables
- Check and replenish coolant level
- Clean or replace cabin air filter
- Replace fuel filter
- Lubricate hinges
- Rotate tires and reset TPMS
- Inspect the following:
  - Engine for leaks
  - Exhaust for leaks
  - Transmission for leaks
  - Final drive(s) for leaks
  - Drive belts
  - All lighting
  - Horn operation
  - Ball joints and dust covers
  - Drive shaft boots
  - Drive axle play
  - Water drain for A/C
  - Engine air filter
  - Steering linkage and boots
  - Re-torque drive shaft bolt
  - Tighten nuts and bolts on chassis

30,000 MILES OR 36 MONTHS

(Same as 5,000 miles and 6 months) ***Plus****:*

- Replace cabin filter
- Rotate tires and reset TPMS
- Replace engine air filter
- In addition, inspect the following:
  - Brake lines and hoses
  - Differential oil
  - Engine coolant
  - Exhaust pipes and mountings
  - Fuel lines and connections, fuel tank band and fuel tank vapor system hoses
  - Fuel tank cap gasket
  - Radiator core and condenser
  - Steering gear box
  - Steering linkage and boots
  - Transmission fluid or oil

Additional items for special operating conditions

(Same as 5,000 miles and 6 months)

45,000 MILES OR 54 MONTHS

(Same as 15,000 miles and 18 months)

Additional items for special operating conditions

(Same as 6,000 miles and 6 months)

60,000 MILES OR 72 MONTHS

(Same as 15,000 miles and 18 months) ***Plus****:*

- Inspect:
  - Drive belts
  - Engine valve clearance

Additional items for special operating conditions

(Same as 6,000 miles and 6 months) ***Plus****:*

- Replace differential oil
- Replace transmission oil or fluid

75,000 MILES OR 84 MONTHS

(Same as 15,000 miles and 18 months) ***Plus****:*

- Check power-steering fluid
- Inspect:
  - Drive belts
  - Engine valve clearance

Additional items for special operating conditions

(Same as 6,000 miles and 6 months)

FIGURE 1-6 A typical preventive maintenance schedule.

not cover problems that result. For example, if the engine fails during the period covered by the warranty, the warranty may not cover the engine if the owner does not have proof that the engine's oil was changed according to the recommended schedule and with the correct oil.

Warranties A new car warranty is an agreement by the auto manufacturer to have its authorized dealers repair, replace, or adjust certain parts if they become defective. This agreement typically lasts until the vehicle has been driven 36,000 miles (58,000 km), and/or has been owned for 3 years. However, some manufacturers offer warranties that cover some systems as long as 100,000 miles (161,000 km) or 10 years.

The details of most warranties vary with the manufacturer, vehicle model, and year. Most manufacturers also provide a separate warranty for the powertrain (engine, transmission, and so on) that covers these parts for a longer period than the basic warranty. There are also additional warranties for other systems or components of the vehicle.

Often, according to the terms of the warranty, the owner must pay a certain amount of money called the **deductible**. The manufacturer pays for all repair costs over the deductible amount.

Battery and tire warranties are often prorated, which means that the amount of the repair bill covered by the warranty decreases over time. For example, a battery with a 72-month warranty fails after 60 months. The original price of the battery is divided by 72 and the cost per month is then multiplied by the months remaining in the warranty period. Some warranties are held by a third party, such as the manufacturer of the battery or tires. Although the manufacturer sold the vehicle with the battery or set of tires, their warranty is the responsibility of the maker of that part.

There are also two government-mandated warranties: the Federal Emissions Defect Warranty and the Federal Emissions Performance Warranty. The Federal Emissions Defect Warranty ensures that the vehicle meets all required emissions regulations and that the vehicle's emission control system works as designed and will continue to do so for 2 years or 24,000 miles. The warranty does not cover problems caused by accidents, floods, misuse, modifications, poor maintenance, or the use of leaded fuels. The systems typically covered by this warranty are:

- Air induction
- Fuel metering
- Ignition
- Exhaust
- Positive crankcase ventilation
- Fuel evaporative control
- Emission control system sensors

The Federal Emissions Performance Warranty covers the catalytic converter(s) and engine control module for a period of 8 years or 80,000 miles (129,000 km). If the owner properly maintains the vehicle and it fails an emissions test approved by the Environmental Protection Agency (EPA), an authorized service facility will repair or replace the emission-related parts covered by the warranty at no cost to the owner. Some states, such as California, require the manufacturers to offer additional or extended warranties.

The manufacturers of hybrid vehicles typically have a warranty on the vehicle's battery that covers 8 to 10 years and up to 100,000 miles (161,000 km). This is important because the batteries may cost thousands of dollars.

All warranty information can be found in the vehicle's owner's manual. Whenever there are questions about the warranties, carefully read that section in the owner's manual. If you are working on a vehicle and know that the part or system is covered under a warranty, make sure to tell the customer before proceeding with your work. Doing this will save the customer money and you will earn his or her trust.

Career Opportunities

Automotive technicians can enjoy careers in many different types of automotive businesses **(Figure 1–7)**. Because of the skills required to be a qualified technician, there are also career opportunities for those who do not want to repair automobiles the rest of their lives. The knowledge required to be a good technician can open many doors of opportunity.

Dealerships New car dealerships **(Figure 1–8)** serve as the link between the vehicle manufacturer and the customer. They are privately owned businesses. Most dealerships are franchised operations, which means the owners have signed a contract with particular auto manufacturers and have agreed to sell and service their vehicles.

The manufacturer usually sets the sales and service policies of the dealership. Most warranty repair work is done at the dealership. The manufacturer then pays the dealership for making the repair. The manufacturer also provides the service department at the dealership with the training, special tools, equipment, and information needed to repair its vehicles. The manufacturers also help the dealerships get service business. Often, their commercials

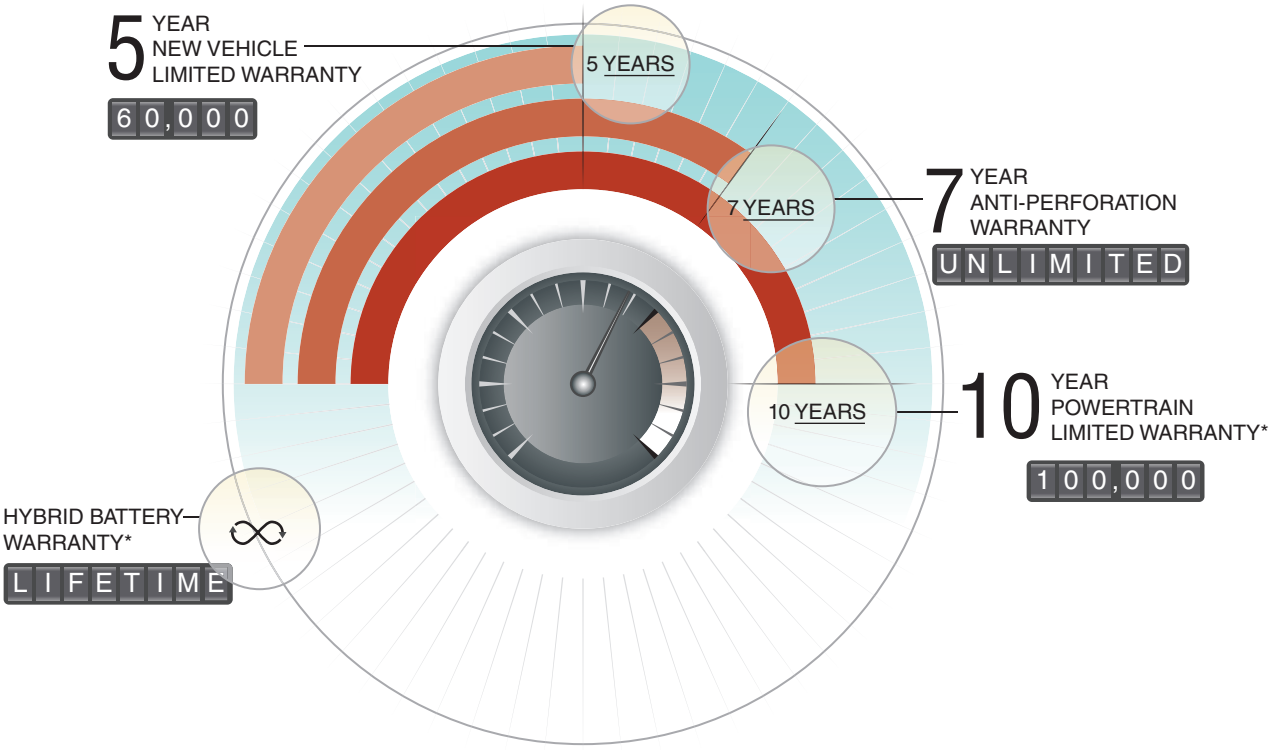


FIGURE 1–7 An example of different warranties all on one vehicle.

stress the importance of using their replacement parts and promote their technicians as the most qualified to work on their products.

Working for a new car dealership can have many advantages. Technical support, equipment, and the opportunity for ongoing training are usually excellent. At a dealership, you have a chance to become very skillful in working on the vehicles you service. However, working on one or two types of vehicles does not appeal to everyone. Some technicians want diversity.

Independent Service Shops Independent shops **(Figure 1–9)** may service all types of vehicles or may specialize in particular types of cars and trucks, or specific systems of a car. Independent shops outnumber dealerships by six to one. As the name states, an independent service shop is not associated with any particular automobile manufacturer. Many independent shops are started by technicians eager to be their own boss and run their own business.

FIGURE 1–8 Dealerships sell and service vehicles made by specific auto manufacturers.

FIGURE 1–9 Full-service gasoline stations are not as common as they used to be, but they are a good example of an independent service shop.

FIGURE 1–10 A bay in an independent service shop.

An independent shop may range in size from a two-bay garage with two to four technicians to a multiple-bay service center with twenty to thirty technicians. A bay is simply a work area for a complete vehicle **(Figure 1–10)**. The amount of equipment in an independent shop varies; however, most are well equipped to do the work they do best. Working in an independent shop may help you develop into a well-rounded technician.

Specialty shops specialize in areas such as engine rebuilding, transmission overhauling, and air conditioning, brake, exhaust, cooling, emissions, and electrical work. A popular type of specialty shop is the "quick lube" shop, which takes care of the PM of vehicles. It hires lubrication specialists who change fluids, belts, and hoses in addition to checking certain safety items on the vehicle.

The number of specialty shops that service and repair one or two systems of the automobile have steadily increased over the past 10 to 20 years. Technicians employed by these shops have the opportunity to become very skillful in one particular area of service.

Franchise Repair Shop A great number of jobs are available at service shops that are run by large companies such as Firestone, Goodyear, and Midas. These shops do not normally service and repair all of the systems of the automobile. However, their customers do come in with a variety of service needs. Technicians employed by these shops have the opportunity to become very proficient in many areas of service and repair.

FIGURE 1–11 Independent repair shops are often affiliated with a large business. In these arrangements, the shops are still run independently.

Some independent shops may look like they are part of a franchise but are actually independent. Good examples of this type of shop are the NAPA service centers **(Figure 1–11)**. These centers are not controlled by NAPA, nor are they franchises of NAPA. They are called NAPA service centers because the facility has met NAPA's standards of quality and the owner has agreed to use NAPA as the primary source of parts and equipment.

Store-Associated Shops Other major employers of auto technicians are the service departments of department stores. Many large stores that sell automotive parts often offer certain types of automotive services, such as brake, exhaust system, and wheel and tire work.

Fleet Service and Maintenance Any company that relies on several vehicles to do its business faces an ongoing vehicle service and PM problem. Small fleets often send their vehicles to an independent shop for maintenance and repair. Large fleets, however, usually have their own PM and repair facilities and technicians **(Figure 1–12)**.

Utility companies (such as electric, telephone, or cable TV), car rental companies, overnight delivery services, and taxicab companies are good examples of businesses that usually have their own service departments. These companies normally purchase their vehicles from one manufacturer. Technicians who work on these fleets have the same opportunities and benefits as technicians in a dealership. In fact, the technicians of some large fleets are authorized to do warranty work for the manufacturer. Many good career opportunities are available in this segment of the auto service industry.

FIGURE 1–12 Large fleets usually have their own preventive maintenance and repair facilities and technicians.

Job Classifications

The automotive industry offers numerous types of employment for people with a good understanding of automotive systems.

Service Technician

A service technician **(Figure 1–13)** diagnoses vehicle problems, performs all necessary tests, and competently repairs or replaces faulty components. The skills to do this job are based on a sound understanding of auto technology, on-the-job experience, and continuous training in new technology as it is introduced by auto manufacturers.

Individuals skilled in automotive service are called technicians, not mechanics. There is a good reason for this. *Mechanic* stresses the ability to repair and service mechanical systems. While this skill is still very much needed, it is only part of the technician's overall job. Today's vehicles require mechanical knowledge plus an understanding of other technologies, such as electronics, hydraulics, and pneumatics.

A technician may work on all systems of the car or may become specialized. Specialty technicians concentrate on servicing one system of the automobile, such as electrical, brakes **(Figure 1–14)**, or transmission. These specialties

FIGURE 1–13 A service technician troubleshoots problems, performs all necessary diagnostic tests, and competently repairs or replaces faulty components.

FIGURE 1–14 Specialty technicians work on only one vehicle system, such as brakes.

require advanced and continuous training in that particular field.

In many automotive shops, the technician also has the responsibility for diagnosing the concerns of the customer and preparing a cost estimate for the required services.

Often individuals begin their career as a technician in a new car dealership by performing new car preparation, commonly referred to as "new car prep." The basic purpose of new car prep is to make a vehicle ready to be delivered to a customer. Each dealership has a list of items and services that are performed prior to delivery. Some of the services may include removing the protective plastic from the vehicle's exterior and interior and installing floor mats. At times, new car prep includes tightening certain bolts that may have been intentionally left loose for shipping. New car prep is a great way for a new technician to become familiar with the vehicles sold at the dealership.

Shop Foreman

The **shop foreman** is the one who helps technicians with more difficult tasks and serves as the quality control expert. In some shops, this is the role of the lead tech. For the most part, both jobs are the same. Some shops have technician teams. On these teams, there are several technicians, each with a different level of expertise. The lead tech is sort of the shop foreman of the team. Lead techs and shop foremen have a good deal of experience and excellent diagnostic skills.

Service Advisor

The person who greets customers at a service center is the **service advisor (Figure 1–15)**, sometimes called a service writer or consultant. Service advisors need to have an understanding of all major systems of an automobile and be able to identify all major components and their locations. They also must be able to describe the function of each of those components and be able to identify related components. A good understanding of the recommended service and maintenance intervals and procedures is also required. With this knowledge they are able to explain the importance and complexity of each service and are able to recommend other services.

A thorough understanding of warranty policies and procedures is also a must. Service advisors

FIGURE 1–15 A service advisor's main job is to record the customer's concerns.

must be able to explain and verify the applicability of warranties, service contracts, service bulletins, and campaign/recalls procedures.

Service advisors also serve as the liaison between the customer and the technician in most dealerships. They have responsibility for explaining the customer's concerns and/or requests to the technician plus keeping track of the progress made by the technician so the customer can be informed. At times, automotive technicians or students of automotive service programs desire a change in career choices but want to stay in the service industry. Becoming a service writer, advisor, or consultant is a good alternative. This job is good for those who have the technical knowledge but lack the desire or physical abilities to physically work on automobiles.

Many of the requirements for being a successful technician apply to being a successful service consultant. However, being a service consultant requires greater skill levels in customer relations, internal communication and relations, and sales. Service consultants must communicate well with customers, over the telephone or in person, in order to satisfy their needs or concerns. Most often this involves the completion of a repair order, which contains the customer's concerns and information and a cost estimate.

Accurate estimates are not only highly appreciated by the customer, but they are also required by law in nearly all states. Writing an accurate estimate requires a solid understanding of the automobile, good communications with the technicians, and good reading and math skills.

Most shops use computers to generate the repair orders and estimates and to schedule the shop's workload. Therefore, having solid computer skills is a must for service advisors.

Service Manager

The service manager is responsible for the operation of the entire service department at a large dealership or independent shop. Normally, customer concerns and complaints are handled by the service manager. Therefore, a good service manager has good people skills in addition to organizational skills and a solid automotive background.

In a dealership, the service manager makes sure the manufacturers' policies on warranties, service procedures, and customer relations are carried out. The service manager also arranges for technician training and keeps all other shop personnel informed and working together.

Service Director

Large new car dealerships often have a service director who oversees the operation of the service and parts departments as well as the body shop. The service director has the main responsibility of keeping the three departments profitable. The service director coordinates the activities of these separate departments to ensure efficiency.

Many service directors began their career as technicians. As technicians they demonstrated a solid knowledge of the automotive field and had outstanding customer relations skills and good business sense. The transition from technician to director typically involves promotion to various other managerial positions first.

Parts Counterperson

A parts counterperson **(Figure 1–16)** can have different duties and is commonly called a parts person or specialist. Parts specialists are found in nearly all automotive dealerships and auto parts retail and wholesale stores. They sell auto parts directly to customers and hand out materials and supplies to technicians working in automotive service facilities and body shops. A parts counterperson must be friendly, professional, and efficient when working with all customers, both on the phone and in person.

Depending on the parts store or department, duties may also include delivering parts, purchasing parts, maintaining inventory levels, and issuing parts to customers and technicians. Responsibilities include preparing purchase orders, scheduling deliveries, assisting in the receipt and storage of parts

FIGURE 1-16 A parts counterperson has an important role in the operation of a store or dealership.

and supplies, and maintaining contact with vendors. An understanding of automotive terminology and systems and good organizational skills are a must for parts counterpersons.

This career is an excellent alternative for those who know about cars but would rather not work on them. Much of the knowledge required to be a technician is also required for a parts person. However, a parts specialist requires a different set of skills. Most automotive parts specialists acquire the sales and customer service skills needed to be successful primarily through on-the-job experience and training. They may also gain the necessary technical knowledge on the job or through educational programs and/or experience. To better understand the world of the parts industry refer to **Figure 1–17**, which defines the common terms used by parts personnel.

Parts Manager

The parts manager is in charge of ordering all replacement parts for the repairs the shop performs. The ordering and timely delivery of parts is extremely important for the smooth operation of the shop. Delays in obtaining parts or omitting a small but crucial part from the initial parts order can cause frustrating holdups for both the service technicians and customers.

Most dealerships and large independent shops keep an inventory of commonly used parts, such as filters, belts, hoses, and gaskets. The parts manager is responsible for maintaining this inventory.

Related Career Opportunities

In addition to careers in automotive service, there are many other job opportunities directly related to the automotive industry.

Parts Distribution

The **aftermarket** refers to the network of businesses **(Figure 1–18)** that supplies replacement parts to independent service shops, car and truck dealerships, fleet operations, and the general public.

Vehicle manufacturers and independent parts manufacturers sell and supply parts to approximately a thousand warehouse distributors throughout the United States. These **warehouse distributors (WDs)** carry substantial inventories of many part lines.

Warehouse distributors serve as large distribution centers. WDs sell and supply parts to parts wholesalers, commonly known as jobbers.

Jobbers sell parts and supplies to shops and do-it-yourselfers. Jobbers often have a delivery service that gets the desired parts to a shop shortly after it ordered them. Some parts stores focus on individual or walk-in customers. These businesses offer the do-it-yourselfers repair advice, and some even offer testing of old components. Selling good parts at a reasonable price and offering extra services to their customers are the characteristics of successful parts stores. Many jobbers operate machine shops that offer another source of employment for skilled technicians. Jobbers or parts stores can be independently owned and operated. They can also be part of a larger national chain **(Figure 1–19)**. Auto manufacturers have also set up their own parts distribution systems to their dealerships and authorized service outlets. Parts manufactured by the original vehicle manufacturer are called **original equipment manufacturer (OEM)** parts.

Opportunities for employment exist at all levels in the parts distribution network, from warehouse distributors to the counter people at local jobber outlets.

Marketing and Sales

Companies that manufacture equipment and parts for the service industry are constantly searching for knowledgeable people to represent and sell their products. For example, a sales representative working for an aftermarket parts manufacturer should have a good knowledge of the company's products. The sales representative also works with WDs, jobbers, and service shops to make sure the parts are being sold and installed correctly. They also help coordinate training and supply information so that everyone using their products is properly trained and informed.

Other Opportunities

Other career possibilities for those trained in automotive service include automobile and truck recyclers, insurance company claims adjusters, auto body shop technicians, and trainers for the various manufacturers or instructors for an automotive training or educational program **(Figure 1–20)**. The latter two careers require solid experience and a thorough understanding of the automobile. It is not easy being

ACCOUNTS RECEIVABLE	Money due from a customer.	PERPETUAL INVENTORY	A method of keeping a continuous record of stock on-hand through sales receipts and/or invoices.
BACK ORDER	Parts ordered from a supplier that have not been shipped to the store or shop because supplier has none in their inventory.	PHYSICAL INVENTORY	The process whereby each part is manually counted and the number on-hand is written on a form or entered into a computer.
BILL OF LADING	A shipping document acknowledging receipt of goods and stating terms of delivery.	PROFIT	The amount received for goods or services above the shop's or store's cost for the part or service.
CORE CHARGE	A charge that is added when a customer buys a remanufactured part. Core charges are refunded to the customer when he or she returns a rebuildable part.	PURCHASE ORDER	A form giving someone the authority to purchase goods or services for a company.
DEALERS	The jobber's wholesale customers, such as service stations, garages, and car dealers, who install parts in their customers' vehicles.	REMANUFAC-TURED PART	A part that has been reconditioned to its original specifications and standards.
DISCOUNT	The amount of savings being offered to a customer, this is normally expressed as a percentage.	RESTOCKING FEE	The fee charged by a store or supplier for having to handle a returned part.
DISTRIBUTOR	A large volume parts stocking business that sells to wholesalers.	RETAIL	Selling merchandise to "walk-in" trade (do-it-yourselfers).
FREIGHT CHARGE	A charge added to special order parts to cover their transportation to the store.	RETURN POLICY	A policy regarding the return of unwanted and unneeded parts. Return policies may include restocking fees or prohibit the return of certain parts.
GROSS PROFIT	The selling price of a part minus its cost (called referred to the margin).	SELLING PRICE	The price at which a part is sold. This price will vary according to the type of customer (retail or wholesale) that is purchasing the part.
INVENTORY	The parts a store or shop has in its possession for resale.	SPECIAL ORDER	An order placed whenever a customer purchases an item not normally kept in stock.
INVENTORY CONTROL	A method of determining amounts of merchandise to order based on supplies on-hand and past sales of the item.	STOCK ORDER	A process by which the store orders more stock from its suppliers in order to maintain its inventory.
INVOICE	The record of a sale to a customer.	STOCK ROTATION	Selling the older stock on-hand before selling the newer stock.
LIST PRICE	The suggested selling price for an item.	TURNOVER	The number of times each year that a business buys, sells, and replaces a part.
MARGIN	Same as gross profit.	VENDOR	The supplier.
MARK-UP	The amount a business charges for a part above the actual cost of the part.	WARRANTY RETURN	A defective part returned to the supplier due to failure during its warranty period.
NO-RETURN POLICY	A store policy that certain parts cannot be returned after purchase. It is common to have a no-return policy on electrical and electronic parts.	WAREHOUSE DISTRIBUTOR	The jobber's supplier who is the link between the manufacturer and the jobber.
ON-HAND	The quantity of an item that the store or shop has in its possession.	WHOLESALE PRICE	The business' price to large volume customers.

FIGURE 1–17 Some of the common terms used by parts personnel.

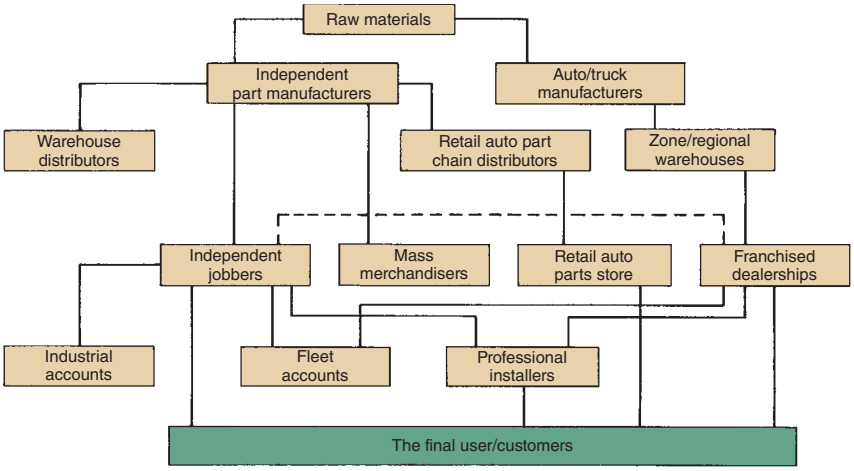


FIGURE 1-18 The auto parts supply network.

FIGURE 1-19 Many parts stores are part of a national corporation with stores located across the country.

FIGURE 1-20 A career possibility for an experienced technician is that of a trainer for the various manufacturers or instructors for an automotive program.

an instructor or trainer; however, passing on knowledge can be very rewarding. Undoubtedly, there is no other career that can have as much impact on the automotive service industry as that of a trainer or instructor.

Training for a Career in Automotive Service

Those interested in a career in auto service can receive training in formal school settings—secondary, postsecondary, and vocational schools; and technical or community colleges, both private and public.

Student Work Experience

There are many ways to gain work experience while you are a student. You may already be involved in one of the following; if not, consider becoming involved in one of these programs.

Job Shadowing Program In this program you follow an experienced technician or service writer. The primary objective is to expose you to the "real world," to see what it takes to be a successful technician or service writer. By job shadowing, you will also become familiar with the total operation of a service department.

Mentoring Program This program is not the most common program, but it can be one of the most valuable. In a mentoring program, you experience the duties and responsibilities of a technician while you have someone who is successful to use as an expert. Your mentor has agreed to stay in contact with you, to answer questions, and to encourage you. When you have a good mentor, you have someone who may be able to explain things a little differently than the way things are explained in class. A mentor may also be able to give real life

examples of why some of the things you need to learn are important.

Cooperative Education and Apprenticeship Programs These programs are typically 2 years in length. One year is spent in school and the other in a dealership or service facility. This does not mean that 1 solid year is spent in school; rather in a cooperative program you spend 8 to 12 weeks at school, and then work for 8 to 12 weeks. The switching back and forth continues for 2 years. Not only do you earn an hourly wage while you are working, you also earn credit toward your degree or diploma. Your work experiences are carefully coordinated with your experiences at school; therefore, it is called a cooperative program—industry cooperates with education. Examples of this type of program are the Chrysler CAPS, Ford ASSET, GM ASEP, and Toyota T-Ten (in Canada these are called T-TEP) programs.

An apprenticeship program combines work experiences with education. The primary difference between the two programs is that in an apprenticeship program students attend classes in the evening after completing a day's work. During this rigorous training program, you receive a decent hourly wage and plenty of good experience. You start the program as a helper to an experienced technician and can begin to do more on your own as you progress through the program. In both cases, while you work you get a chance to practice what you learned in school.

Part-Time Employment The success of this experience depends on you and your drive to learn. Working part-time will bring you good experience, some income, and a good start in getting a great full-time position after you have completed school. The best way to approach this is to find a position and service facility that will allow you to grow. You need to start at a right level and be able to take on more difficult tasks when you are ready. The most difficult challenge when working part-time is to keep up with your education while you are working. Many times work may get in the way, but if you truly want to learn, you will find a way to fit your education around your work schedule.

Postgraduate Education A few manufacturer programs are designed for graduates of postsecondary schools. These programs train individuals to work on particular vehicles. For example, BMW's Service Technician Education Program (STEP) is a scholarship program for the top graduates of automotive postsecondary schools. Students in the program apply what they learned in their 2-year program and learn to diagnose and service BMW products. BMW says this program is the most respected and intense training program of its kind in the world. For more information go to http://www.bmwstep.com.

The Need for Continuous Learning

Training in automotive technology and service does not end with graduation nor does the *need to read* end. A professional technician constantly learns and keeps up to date. In order to maintain your image as a professional and to keep your knowledge and skills up to date, you need to do what you can to learn new things. You need to commit yourself to lifelong learning.

There are many ways in which you can keep up with the changing technology. Short courses on specific systems or changes are available from the manufacturers and a number of companies that offer formal training, such as Federal Mogul, NAPA, AC Delco, and local parts jobbers. There are also many online sources available, from companies like those listed above to many that specialize in technician training. It is wise to attend update classes as soon as you can. If you wait too long, you may have a difficult time catching up with the ever-changing technologies.

In addition to taking classes, you can learn by reading automotive magazines or the newest editions of automotive textbooks. A good technician takes advantage of every opportunity to learn.

ASE Certification

The National Institute for **Automotive Service Excellence (ASE)** has established a voluntary certification program for automotive, heavy-duty truck, and auto body repair technicians along with parts specialist certifications. In addition to these programs, ASE also offers individual testing in the areas of automotive and heavy-duty truck parts, service consultant, alternate fuels, advanced engine performance, and a variety of other areas. This certification system combines voluntary testing with on-the-job experience to confirm that technicians have the skills needed to work on today's more complex vehicles. ASE recognizes two distinct levels of service capability—the automotive technician and the master automotive technician. The master automotive technician is certified by ASE in all major automotive systems.

To become ASE certified, a technician must pass one or more tests that stress system diagnosis and repair procedures. The eight basic certification areas in automotive repair follow:

1. Engine repair
2. Automatic transmission/transaxle
3. Manual transmissions and drive axles
4. Suspension and steering
5. Brakes
6. Electrical systems
7. Heating and air conditioning
8. Engine performance (driveability)

After passing at least one exam and providing proof of 2 years of hands-on work experience, the technician becomes ASE certified. Retesting is necessary every 5 years to remain certified. A technician who passes one examination receives an automotive technician shoulder patch. The master automotive technician patch is awarded to technicians who pass all eight of the basic automotive certification exams **(Figure 1–21)**.

ASE also offers advanced-level certification in some areas. The most common advanced certification for automobile technicians is the L1 or Advanced Engine Performance. Individuals seeking this certification must be certified in Electricity and Engine Performance before taking this exam. Another advanced certification is the Electronic Diesel Engine Diagnosis Specialist (L2). To receive this certification, a technician must be currently certified in one of the ASE Diesel Engine areas and one of the ASE Electrical/Electronic Systems areas.

ASE also offers specialist certifications. For example, you can become certified in Undercar–Exhaust Systems, Light Vehicle Diesel, Engine Machining, Alternative Fuels, Collision Repair, or as a Parts Counterperson or a Service Consultant. Go to: *www.ase.com* for more information.

FIGURE 1–21 ASE certification shoulder patches worn by (*left*) automotive technicians and (*right*) master automotive technicians.

As mentioned, ASE certification requires that you have 2 years of full-time, hands-on working experience as an automotive technician. You may receive credit toward this 2-year experience requirement by completing formal training in one or a combination of high school or post–high school education, short technical courses, and cooperative or apprenticeship programs.

In 2012, ASE began offering ASE Student Certification tests. These are computer-based tests available in the spring and fall each year for students enrolled in any automotive technology program. Tests are available for automotive, collision repair and refinishing, and medium/heavy-duty truck. Each certification is valid for 2 years from the date taken.

ASE Tests

ASE tests are designed to check your understanding of how automotive systems and components operate as well as your ability to diagnose problems and determine the correct repairs. Certification tests contain between 40 and 75 multiple-choice questions. Question types include the following:

- Direct, most likely, or completion questions
- Technician A/Technician B questions
- *Except* or *least likely* questions

The questions are written by a panel of technical service experts, including domestic and import vehicle manufacturers, repair and test equipment and parts manufacturers, working automotive technicians, and automotive instructors. All questions are pretested and quality checked on a national sample of technicians before they are included in the actual test. Many test questions force the student to choose between two distinct repair or diagnostic methods. Examples of these questions are included at the end of each chapter.

When taking ASE-style tests, first read the entire question to determine what the subject or intent of the question is about. Next, try to eliminate possible choices based on your knowledge and experience and choose the answer that seems the most likely. Technician A/Technician B questions can be treated as two separate True/False questions; is Technician A correct? Yes or No. Is Technician B correct? Yes or No. Once you have answered all the questions, you

can go back and review your answers before submitting the test. Be careful to not overthink and talk yourself out of an answer by thinking of all possible exceptions to the question.

ASE Education Foundation Program Accreditation

While each automotive program is different, most share some similarities. Many high school programs and many post-secondary schools have been evaluated and are accredited by the ASE Education Foundation. To become accredited by the ASE Education Foundation, a program must show documentation of what is covered in the program and the amount of time spent in each of the ASE areas. The programs must also pass an onsite evaluation. Accredited programs display the sign shown in **Figure 1–22**. This means the school is teaching the competencies and to the standards prescribed by ASE. Because of this standardization, all of the core skills taught in each and every certified program is the same. More information can be found at www.asealliance.org.

FIGURE 1–22 A sign showing an automotive program is ASE certified.

KEY TERMS

Aftermarket
Automotive Service Excellence (ASE)
Deductible
Jobbers
Original equipment manufacturer (OEM)
Preventive maintenance (PM)
Service advisor
Shop foreman
Warehouse distributors (WDs)

SUMMARY

- The auto industry is a global industry involving vehicle and parts manufacturers from many countries.
- Electronic controls are found in most auto systems, including engines, transmissions, brakes, steering systems, and suspensions. Preventive maintenance is extremely important in keeping today's vehicles in good working order.
- New car dealerships, independent service shops, specialty service shops, fleet operators, and many other businesses are in great need of qualified service technicians.
- A solid background in auto technology may be the basis for many other types of careers within the industry. Some examples are parts management, collision damage appraisal, sales, and marketing positions.
- Training in auto technology is available from many types of secondary, vocational, and technical schools. Auto manufacturers also have cooperative programs with schools to ensure that graduates understand modern systems and the equipment to service them.
- The National Institute for Automotive Service Excellence (ASE) actively promotes professionalism within the industry. Its voluntary certification program for automotive technicians and master automotive technicians helps guarantee a high level of quality service.
- The ASE certification process involves both written tests and credit for on-the-job experience. Testing is available in many areas of auto technology.

REVIEW QUESTIONS

Short Answer

1. List at least five different types of businesses that hire technicians. Describe the types of work these businesses handle and the advantages and disadvantages of working for them.
2. Name the different ways to gain work experience while you are a student.
3. Explain the implied difference between someone who is called a mechanic and one who is called an automotive technician.
4. Explain the basic requirements for becoming a successful automotive technician.

Multiple Choice

1. Which of the following have had a significant impact on the automotive industry?
   a. Emission laws
   b. Electronics
   c. New technologies
   d. All of the above
2. Individuals often begin a career as an automotive technician in a new car dealership by ___, which is a good way for a new technician to become familiar with the vehicles sold at the dealership.
   a. working at the parts counter
   b. performing new car prep
   c. being a service advisor
   d. serving as the lead tech
3. Technician A says a hybrid vehicle uses two different power sources. Technician B says a hybrid vehicle may use either a gas engine or electric motor to drive the wheels. Who is correct?
   a. Technician A
   b. Technician B
   c. Both A and B
   d. Neither A nor B
4. The government-mandated warranty that specifically covers the catalytic converter(s) and engine control module is the ___.
   a. Federal Emissions Defect Warranty
   b. Federal Powertrain Warranty
   c. Federal Emissions Performance Warranty
   d. Extended Federal Exhaust Warranty
5. Which of the following is typically included in a scheduled preventive maintenance program?
   a. Oil and filter changes
   b. Coolant and lubrication services
   c. Replacement of filters
   d. All of the above
6. In a large new car dealership, the individual who oversees the operation of the service department, parts department, and body shop is the ___.
   a. service manager
   b. service director
   c. shop foreman
   d. parts manager
7. Repair work performed on vehicles still under the manufacturer's warranty is usually performed by ___.
   a. independent service shops
   b. dealerships
   c. specialty shops
   d. Either A or B
8. Which of the following businesses perform work on only one or two automotive systems?
   a. Dealerships
   b. Independent service shops
   c. Specialty shops
   d. Fleet service departments
9. Normally, whose job is it to greet the customer and complete the repair or work order?
   a. Service manager
   b. Parts manager
   c. Automotive technician
   d. Service advisor
10. Technician A says that *all* an individual needs to do in order to become certified by ASE in a particular area is to pass the certification exam in that area. Technician B says that the questions on an ASE exam often force the test taker to choose between two distinct repair methods. Who is correct?
    a. Technician A
    b. Technician B
    c. Both A and B
    d. Neither A nor B

11. To be successful, today's automotive technician must have ___.
    a. an understanding of electronics
    b. the ability to repair and service mechanical systems
    c. the dedication to always be learning something new
    d. All of the above
12. A technician must have a minimum of ___ year(s) of hands-on work experience to get ASE certification.
    a. 1
    b. 2
    c. 3
    d. 4
13. An experienced technician who passes all eight basic ASE automotive certification tests is certified as a(n) ___.
    a. automotive technician
    b. master automotive technician
    c. service manager
    d. parts manager
14. Technician A says battery warranties are often prorated. Technician B says some warranties have a deductible. Who is correct?
    a. Technician A
    b. Technician B
    c. Both A and B
    d. Neither A nor B
15. Wholesale auto parts stores that sell aftermarket parts and supplies to service shops and the general public are called ___.
    a. warehouse distributors
    b. mass merchandisers
    c. jobbers
    d. freelancers
16. Ongoing technical training and support is available from ___.
    a. aftermarket parts manufacturers
    b. auto manufacturers
    c. online resources
    d. All of the above

CHAPTER 2

WORKPLACE SKILLS

OBJECTIVES

- Develop a personal employment plan.
- Seek and apply for employment.
- Prepare a resume and cover letter.
- Prepare for an employment interview.
- Accept employment.
- Understand how automotive technicians are compensated.
- Understand the proper relationship between an employer and an employee.
- Explain the key elements of on-the-job communications.
- Be able to use critical thinking and problem-solving skills.
- Explain how you should look and act to be regarded as a professional.
- Explain how fellow workers and customers should be treated.

This chapter gives an overview of what you should do to get a job and how to keep it. The basis for this discussion is respect—respect for yourself, your employer, fellow employees, your customers, and everyone else. Also included in this discussion are the key personal characteristics required of all seeking to be successful automotive technicians and employees.

Seeking and Applying for Employment

Becoming employed, especially in the field in which you want a career, involves many steps. As with many things in life, you must be adequately prepared before taking the next step toward employment. This discussion suggests ways you can prepare and what to expect while taking these steps.

Employment Plan

An employment plan is nothing more than an honest appraisal of yourself and your career hopes. The plan should include your employment goals, a timetable for reaching those goals, and a prioritized list of potential employers or types of employers. You may need to share your employment plan with someone while you are seeking employment, so make sure it is complete. Even if no one else will see it, you should be as thorough as possible because it will help keep you focused during your quest for employment.

Think about the type of job you want and do some research to find out what is required to get that

job. Evaluate yourself against those requirements. If you do not meet the requirements, set up a plan for obtaining the needed skills. Also, consider the working conditions of that type of job. Are you willing and able to be a productive worker in those conditions? If not, find a job that is similar to your desires and pursue that career.

Self-Appraisal To begin the self-appraisal part of your employment plan, ask yourself:

- Why am I looking for a job?
- What specifically do I hope to gain by having a job?
- What do I like to do?
- What am I good at?
- Which of my skills would I like to use in my job?
- What skills do I currently have that would make me employable?

By honestly answering these questions, you should be able to identify the jobs that will help you meet your goals. If you are just seeking a job to pay bills or buy a car and have no intention of turning this job into a career, be honest with yourself and your potential employer. If you are hoping to begin a successful career, realize you will probably start at the bottom of the ladder to success. You must also realize that how quickly you climb the ladder is your responsibility. An employer's responsibility is merely to give you a fair chance to climb it.

Identifying Your Skills Honestly evaluate yourself and your life to determine what skills you have. Even if you have never had a job, you still have skills and talents that can make you a desirable employee. Make a list of all of the things you have learned from your school, friends, and family and through television, volunteering, books, hobbies, and so on. You may be surprised by the number of skills you have. Identify these skills as being either technical or personal skills.

Technical skills include things you can do well and enjoy, such as:

- Using a computer
- Working with tools, machines, or equipment
- Doing math problems
- Maintaining or fixing things
- Figuring out how things work
- Making things with your hands
- Working with ideas and information
- Solving puzzles or problems
- Studying or reading
- Doing experiments or researching a topic
- Expressing yourself through writing

Personal skills are also called soft skills and are things that are part of your personality. These are things you are good at or enjoy doing, such as:

- Working with people
- Caring for or helping people
- Working as a member of a team and independently
- Leading or supervising others
- Following orders or instructions
- Persuading people
- Negotiating with others

By identifying these skills, you will have created your personal skills inventory. From the inventory you should match your skills and personality to the needs and desires of potential employers. The inventory will also come in handy when marketing yourself for a job, such as when preparing your resume and cover letter and during an interview.

Identifying Job Possibilities

One of the things you identified in your employment plan was your preferred place to work. This may have been a specific business or a type of business, such as a new car dealership or independent shop. Now your task is to identify the companies that are looking for someone. There are many ways of doing this, including the following:

- Checking your school's job posting board or with a placement coordinator
- Searching job websites, such as monster.com and indeed.com
- Checking the employment web pages of local business for job openings **(Figure 2–1)**

You can also ask people you know who already work in the business. If there is nothing available in the business you prefer, look for openings in the type of business that was second on your priority list.

Do not limit your job search to just looking at help wanted ads or websites. If you are interested in working at a particular shop, visit the shop and talk to people who work there. Speak with the manager about being in an automotive program and about current or forthcoming job openings. If a job is not currently available, you may be able to intern in the

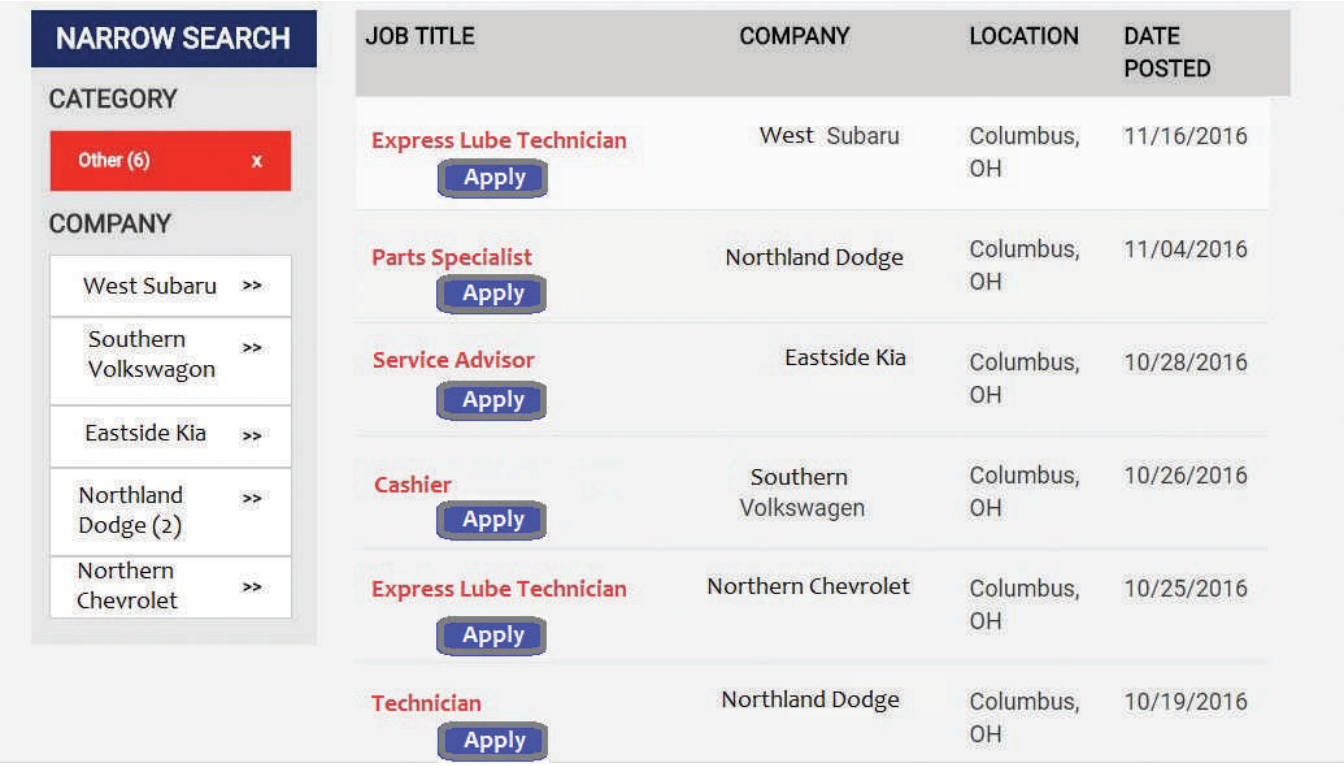


FIGURE 2–1 Check the employment or career sections of websites for businesses that are looking for technicians.

shop, without pay, but as a way to gain experience and to be ready when the next opening occurs.

Carefully look at the description of the job. Make sure you meet the qualifications for the job before you apply. For example, if you have a drug problem and the ad states that all applicants will be drug tested, you should not bother applying and should concentrate on breaking the habit. Even if the ad says nothing about testing for drug use, you should know that there is no place for drugs at work and continued drug use will only jeopardize your career.

Driving Record Your driving record is something you must also be aware of, and you probably are. If you have a poor record, you may not be considered for a job that requires operating a vehicle. In the same way that a driving record affects your personal car insurance, the employer's insurance costs can also increase because of your poor driving record. A bad driving record or the loss of a driver's license can get in the way of getting or keeping a job.

Also, if you have been convicted or have been arrested, be prepared to let the employer know what happened and what you learned from the experience. If you have been convicted of a felony, the employer must know. Failure to disclose this will cost you the job.

Preparing Your Resume

Your **resume** and cover letter are your own personal marketing tools and may be an employer's first look at you. Although not all employers require a resume, you should prepare one for those that do. Preparing a resume also forces you to look at your qualifications for a job. That alone justifies having a resume.

Keep in mind that although you may spend hours writing and refining your resume, an employer may only take a minute or two from his or her busy schedule to look it over. With this in mind, put together a resume that tells the employer who you are in such a way that he or she wants to interview you.

A resume normally includes your contact information, career objective, skills and/or accomplishments, work experience, education, and a statement about references. There are different formats you can follow when designing your resume. If you have limited work experience, make sure the resume emphasizes your skills and accomplishments rather than work history. Even if you have no work experience, you can sell yourself by highlighting some of the skills and attributes you identified in your employment plan.

When listing or mentioning your attributes and skills, express them in a way that shows how they

relate to the job you are seeking. For instance, if you practice every day at your favorite sport so that you can make the team, you may want to describe yourself as being persistent, determined, motivated, and goal-oriented. Another example is if you have ever pulled an all-nighter to get an assignment done on time, it can mean that you work well under pressure and always get the job done. Another example would be if you keep your promises and do what you said you would do, you may want to describe yourself as reliable, a person who takes commitment seriously.

Identifying your skills may be a difficult task, so have your family and/or friends help you. Keep in mind that you have qualities and skills that employers want. You need to recognize them, put them in a resume, and tell them to your potential employer. Do not put the responsibility of figuring out who you are on the employers—tell them.

Figure 2–2 is an example of a basic resume for an individual seeking an entry-level position as a technician.

Putting Together an Effective Resume Follow these guidelines while preparing and writing your resume:

- Make sure your resume is neat, uncluttered, and easy to read.
- Use quality white paper.
- Keep it short—one page is best.

Jack Erjavec
1234 My Street
Somewhere, OZ 99902
123-456-7890

Performance oriented student, with an excellent reputation as a responsible and hard-working achiever, seeking a position as an entry-level automotive technician in a new car dealership.

Skills and Attributes

- People oriented
- Motivated
- Committed
- Honest
- Reliable
- Creative problem-solver
- Good hand skills

Work Experience

2015–2017 Somewhere Soccer Association (Assistant coach)

- Instructed and supervised junior team
- Performed administrative tasks as the Coach required

2013–2017 Carried out various odd jobs within the community

- Washing and waxing cars, picking up children from school, raking leaves, cutting grass

Education

Somewhere Senior High School, graduated in 2017

Somewhere Community College, currently enrolled in the Automotive Technology Program

Extracurricular Activities

2014–2017 Active member of the video game club

2016–2017 Member of the varsity soccer team

Hobbies and activities

Reading auto-related magazines, going to races, doing puzzles, working on cars with family and friends.

References

Available upon request.

FIGURE 2–2 A sample of a resume for someone who has little work experience.

- Let the resume tell your story, but do not try to oversell yourself.
- Use dynamic words to describe your skills and experience, such as accomplished, achieved, communicated, completed, created, delivered, designed, developed, directed, established, founded, instructed, managed, operated, organized, participated, prepared, produced, provided, repaired, and supervised.
- Choose your words carefully; remember that the resume is a look at you.
- Make sure all information is accurate.
- Make sure the information you think is the most important stands out and is positioned near the top of the page.
- Design your resume with a clean letter type (font) and wide margins (1½ inches on both sides is good) so that it is easy on the eyes.
- Only list the "odd" jobs you had if they are related to the job you are applying for.
- Do not repeat information.
- Proofread the entire resume to catch spelling and grammatical errors. If you find them, fix them and print a new, clean copy.

Digital Portfolios

Digital portfolios or online resumes are increasingly becoming more common as people and business move from paper to digital communication. A digital portfolio typically contains a personal mission statement, your resume, references, and examples of your work. Examples of your work may include pictures or short videos of you performing certain tasks as evidence of your skills and knowledge. Other evidence may include examples of assignments you did particularly well on or scanned copies of certifications you have acquired.

Many web hosting sites, such as Wix.com, Weebly, and VisualCV, offer free basic web pages and resume building services. When building your site, a simple, clean, and uncluttered look is more professional looking and easier to read than one crammed with images, crazy colors and fonts. You want potential employers visiting your site to be able to quickly and easily learn about you and your skills and not have to strain to read the content.

References

A **reference** is someone who will be glad to tell a potential employer about you. A reference can be anyone who knows you, other than a family member or close friend. Employers contact references to verify or complete their picture of you. Make a list of three to five people you can use as references, including their contact information. If you do not supply references, the potential employer may assume that you cannot find anyone who has anything nice to say about you. You probably will not be considered for the job.

Choose your references wisely. Teachers (past and present), coaches, and school administrators are good examples of who you can ask to be a reference. People you have worked for or have helped are also good references. Try also to get someone whose opinion is respected, such as a priest, minister, or elder in your church or someone you know well who holds a high position.

Always talk to your references first, and get permission to give their names and telephone numbers to an employer. If they do not seem comfortable with giving you a reference, take the hint and move on to someone else. If someone is willing to provide you with a written reference, make several copies of the letter so that you can attach them to your resume and/or job application. Give copies of your resume to those on your reference list. Make sure to bring your reference list when applying for a job.

Preparing Your Cover Letter

A cover letter **(Figure 2–3)** should be sent with every resume you mail, e-mail, fax, or personally deliver. A cover letter gives you a chance to point out exactly why you are perfect for the job. You should not send out the same cover letter to all potential employers. Adjust the letter to match the company and position you are applying for. Yes, this means a little more work, but it will be worth it. Address the letter to the person doing the hiring. Do NOT use "Dear Sir, Dear Madam, or To Whom it may concern." If the job posting does not give the hiring person's name, you can normally find who to send the resume to by calling the employer and asking to whom to address your cover letter. You can also try checking other business information sites to determine the name of the person conducting the interviewing.

A good cover letter is normally made up of three paragraphs, each with its own purpose.

First Paragraph In the first paragraph, tell the employer that you are interested in working for the company, the position you are interested in, and why. Make sure you let the employer know that you know something about the company and what the job involves. Also include a statement of how you found out about the open position, which could be a help wanted ad, a job posting at school, and/or a referral by someone who works for the company.

Jack Erjavec
1234 My Street
Somewhere, OZ 99902

March 24, 2018

Mrs. Need Someone
Service Manager, Exciting New Cars
56789 Big Dealer Avenue
Somewhere, OZ 99907

Re: application for an entry level automotive technician position

Dear Mrs. Someone:

Your ad in the March 14th edition of the Dogpatch for an automotive technician greatly interested me, as this position is very much in line with my immediate career objective–a career position as an automotive technician in a new car dealership. Because of the people and cars featured at your dealership, I know working there would be exciting.

I have tinkered with cars for most of my life and am currently enrolled in the Automotive Technology program at Somewhere Community College. I chose this program because you are on the advisory council and I knew it must be a good program. I have good hand skills and work hard to be successful. My being on the varsity soccer team for four years should attest to that. I also enjoy working with people and have developed excellent communication skills. The position you have open is a perfect fit for me. A resume detailing my skills and work experience is attached for your review.

I would appreciate an opportunity to meet with you to further discuss my qualifications. In the meantime, many thanks for your consideration, and I look forward to hearing from you soon. I can be reached by phone at 123-456-7890, most weekdays after 2:30 PM. If I am unable to answer the phone when you call, please leave a message and I will return your call as soon as I can. Thanks again.

Sincerely,

Jack Erjavec

encl.

FIGURE 2–3 An example of a cover letter that can be sent with the resume in Figure 2–2.

Second Paragraph In this paragraph, sell yourself by mentioning one or two of your job qualifications and describe them in more detail than you did in your resume. Make sure you expand on the material in your resume rather than simply repeat it. Point out any special training or experience you have that directly relates to the job. When doing this, give a summary without listing the places and dates. This information is listed in your resume so simply refer to the resume for details. This summary is another opportunity for you to let the employer know that you understand what they do, what the job involves, and how you can help them.

Third Paragraph Typically this paragraph is the end or closing of the letter. Make sure you thank the employer for taking the time to review your resume and ask him or her to contact you to make an appointment for an interview. Make sure you give a phone number where you can be reached. If you have particular times when it is best to contact you, put those times in this paragraph. Make sure you have a clear and understandable message on your telephone's answering machine, just in case you miss the employer's call. Also, have an organized work area around the phone so that you can accurately schedule any interview appointments.

Guidelines for Writing an Effective Cover Letter

Follow these guidelines while preparing and writing your cover letter:

- Address the letter to a person, not just a title. If you do not know the person's name, call the company and ask for the correct spelling of the person's name and his or her title.

- Make sure the words you use in the letter are upbeat.
- Use a natural writing style, keeping it professional but friendly.
- Try hard not to start every sentence with "I"; make some "you" statements.
- Check the letter for spelling and grammatical errors. This is a critical step!
- Type the letter on quality paper and make sure it is neat and clean.
- Make sure you sign the letter before sending it.

Contacting Potential Employers

Unless the help wanted ad or job posting tells you otherwise, it is best to drop your resume and cover letter off in person (preferably to the person who does the hiring). When you are doing this, make sure the employer knows who you are and the job you want. Make sure you are prepared for what happens next. You may be given an interview right then. You may be asked to fill out an application. If so, fill it out.

Before you leave, thank the employer and ask if you can call back in a few days if you do not hear from him. If you do not hear back within a week, call to make sure the employer received your resume. If you are told that the job is filled or that no jobs are available, politely thank him for considering you. Ask if it is okay for you to stay in touch in case there is a future job opening.

Employment Application

An application for employment is a legal document that summarizes who you are. It is also another marketing tool for you. Filling out the application is the first task the employer has asked you to do, so do it thoroughly and carefully. Make sure you are prepared to fill out an application before you go. Take your own pen and a paperclip so that you can attach your resume to the application. Make sure you have your reference list. When filling out the application, neatly print your answers.

Read over the entire application before filling it out. Make sure you follow the directions carefully. Read through the application before you fill in the blanks, this gives you a better chance of filling it out neatly and correctly. A messy application or one with crossed out or poorly erased information tells employers you may not care about the quality of your work.

By following the directions on the application and providing the employer with the information asked for, you are demonstrating that you have the ability to read, understand, and follow written instructions, rules, and procedures. When answering the questions, be honest. When you have completed the application, sign it and attach your cover letter and resume to it.

Many companies use electronic applications, which may be only electronic versions of a paper application. Depending on the company, you may complete the application from anywhere or it may require you to complete one at the place of employment. Some companies use online applications that can be linked with Facebook, Google+, and LinkedIn accounts. This form of application may also ask you to upload a current resume. In some cases, online applications also serve as a type of personality test, asking you value or judgment questions designed to determine what type of person you are. It is important to note that many employers will check applicants out on Facebook and other social websites as part of their decision making process. If you have questionable content on your Facebook page or elsewhere, you should consider removing it before beginning your job search.

The Interview

Typically if employers are interested in you, you will be contacted to come in for an interview. This is a good sign. If they were not impressed with what they know of you so far, they will not ask for an interview. Knowing this should give you some confidence as you prepare for the interview.

Although an interview does not last very long, it is a time when you can either get the job or lose it. Get ready for the interview by taking time to learn as much as you can about the company. Think of some of the reasons the company should hire you. When doing this, think of how both of you would benefit. Think of questions you might ask the interviewer to show you are interested in the job and the business. Then make a list of questions that you think the employer might ask. Think about how you should answer each of them and practice the answers with your family and friends. Some of the more common interview questions include:

- What can you tell me about yourself?
- Why are you interested in this job?
- What are your strengths and weaknesses?
- If we employ you, what will you do for us?
- Would you ever lie to me?
- Do you have any questions about us or the job?

Tips for a Successful Interview

- Before the interview, think about what days and hours you can work and when you can start working.
- Make sure you take your social security card (or SIN card), extra copies of your resume, a list of your references and their contact information, as well as copies of any letters of recommendation you may have.
- Take paper and a pen to the interview so that you can take notes. Often the interviewer will be doing the same.
- Try to relax right before the interview.
- Be on time (early is good) for the interview. If you are not exactly sure how to get to the business or what types of problems you may face getting there (such as traffic jams or construction), make a trip there 1 or 2 days before the interview. If you must be late, or if you cannot make it to the interview, call the employer as soon as possible and explain why. Ask if you can arrange for a new interview time.
- Show up looking neat and professional. Wear something more formal than what you would wear on the job.
- Turn your cell phone off or leave it in your car. Don't let your interview be ruined by repeated phone interruptions or wild ringtone or alert sounds.
- When you are greeted by the interviewer, look him or her in the eyes, introduce yourself and be ready to shake hands. Do it firmly but do not show off how strong your grip is!
- Listen closely to the interviewer and look at the interviewer while he or she talks.
- Answer all questions carefully and honestly. If you do not have an immediate answer, think about it before you open your mouth. If you do not understand the question, restate the question in the way you understand it. The interviewer will then know what question you are answering.
- Never answer questions with a simple "yes" or "no." Answer all questions with examples or explanations that show your qualities or skills.
- Market yourself but do not lie about or exaggerate your abilities.
- Show your desire and enthusiasm for the job, but try to be yourself; that is, not too shy or too aggressive.
- Never say anything negative about other people or past employers.
- Do not be overly familiar with the interviewer and do not use slang during the interview, even if the interviewer does.
- Restate your interest in the job and summarize your good points at the end of the interview.
- Ask the interviewer if you can call back in a few days.

After the Interview

After the interview, go to a quiet place and reflect on what just took place. Think about what you did well and what you could have done better. Write these down so that you can refer to them when you are preparing for your next interview.

Within 3 days after the interview, contact the interviewer, thanking him or her for his or her time. Make sure you remind the interviewer of your interest and qualifications. Take advantage of this additional chance to market yourself but do not be overly aggressive when doing this. And, do not beg for the job!

Remember, finding a job takes time and seldom do you land a job on your first attempt. If you do not get a job offer as a result of a first interview, do not give up. Do your best not to feel depressed or dejected. Simply realize that, although you are qualified, someone with more experience was chosen. Send a thank-you letter anyway; this may prompt the interviewer to think of you the next time a similar job becomes available.

Review your cover letter, resume, and interview experience. Identify anything that can improve your marketing tools. Do not feel shy about asking the employer who did not hire you what you could have done better. Discuss your job hunt with your family and friends who will provide support and encouragement. Explore other options. Do not rule out volunteering or job shadowing as a means of connecting with the workplace.

If you do get a job offer, do not be afraid to discuss the terms and conditions before accepting. Find out, or confirm, things such as what you will be doing, the hours you will be working, how you will be paid, and what to do when you report to work the first day. If you have any concerns, do not hesitate to share them with someone whose opinion you respect before committing yourself to the job. Do not commit to the job and then change your mind a few days later. Think seriously about the job before you accept or decline it.

Accepting Employment

When you accept the job, you are entering into an agreement with the employer. That agreement needs to be honored. Make sure you are ready to start

working. You need to have transportation to and from work and the required tools and clothes for the job.

Typically before you begin to work, or at least before you get paid, you will fill out state and federal income tax forms. These forms give the company authorization to deduct income taxes from your wages. When you are an employee, the company must deduct those taxes. One form you will fill out is the employee withholding allowance certificate form, called the W-4. This form tells the employer how much, according to a scale, should be deducted from your pay for taxes. Basically the form asks how many exemptions you would like to claim. What you should claim depends on many things, and it is best that you seek advice from someone before you fill this in. In fact, do this well before you arrive to fill out the form.

Compensation

Automotive technicians can be paid in a number of ways. When deciding on whether or not to accept a job, make sure you understand how you will be paid. Keep in mind that the employer agrees to pay you in exchange for your work, the quality of which is unknown before you start to work. When you accept employment, you accept the terms of compensation offered to you. Do not show up on the first day of work demanding more. After you have started working, progressed on the job, and made the company money, you can ask for more.

Hourly Wages Most often, new or apprentice technicians are paid a fixed wage for every hour they work **(Figure 2–4)**. The amount of pay per hour depends on the business, your skill levels, and the work you will be doing. While collecting an hourly wage, you have a chance to learn the trade and the business. Time is usually spent working with a master technician or doing low-skilled jobs. As you learn more and become more productive, you can earn more. Many shops pay a good hourly rate to their productive technicians. Some have bonus plans that allow technicians to make more when they are highly productive. Nearly all service facilities for fleets pay their technicians an hourly wage.

Commission When technicians are paid on a **commission** basis, they receive a minimum hourly wage plus a percentage of what the shop receives for

SMART Autmotive Repair

Period:	10/14/2016	Employee Name	Rob Thompson	Employee ID	0U812
Tax Status	1	Federal Allowance (From W-4)	0	Hours Worked	32
Hourly Rate	$12.00	Overtime Rate	$18.75	Sick Hours	0
Social Security Tax	$23.81	Federal Income Tax	$29.70	Vacation Hours	0
Medicare Tax	$3.20	State Tax	$5.57	Overtime Hours	0
Insurance Deduction	$0.00	Other Regular Deduction	$3.20	Gross Pay	$384.00
Total Taxes and Regular Deductions	$65.48	Other Deduction	$0.00	Total Taxes and Deductions	$67.85
				Net Pay	$318.52

SMART Automotive Repair, INC.
5150 Speed Way
Columbus, Ohio 43224

Advice number: 0000458852
Pay date: 10/21/2016

Deposited to the account of	account number	transit	ABA	amount
Rob Thompson	xxxxxx5341	xxxx	xxxx	$ 318.52

THIS IS NOT A CHECK

NON-NEGOTIABLE

FIGURE 2–4 Automotive technicians can be paid in a number of ways.

performing various services. This pay system can work well for technicians who are employed in a shop whose business fluctuates through the year. This system, along with the "flat-rate" system, is often referred to as incentive pay systems.

Flat-Rate **Flat-rate** is a pay system in which a technician is paid for the amount of work, meaning labor hours, he or she does. The flat-rate system favors technicians who work in a shop that has a large volume of work. Although this pay plan offers excellent wages, it is not recommended for new and inexperienced technicians.

Every conceivable service to every different model of vehicle has a flat-rate time. These times are assigned by the automobile manufacturers. The times are based on the average time it takes for a team of technicians to perform the service on new vehicle models. Flat-rate times **(Figure 2–5)** are listed in a labor guide, which can be a manual or be available on a computer. As you can see from Figure 2–5, flat-rate times are broken down into tenths of an hour. A job that pays for 3.1 hours means you will be paid for 3 hours and 6 minutes regardless of how long it took to complete the job. To explain how this system works, suppose a technician is paid $15.00 per hour flat-rate. If a job has a flat-rate time of 3.1 hours, the technician will be paid $46.50 for the job, regardless of how long it took to complete it. Experienced technicians beat the flat-rate time nearly all of the time. Their weekly pay is based on the time "turned in," not on the time spent. If the technician turns in 60 hours of work in a 40-hour workweek, he or she actually

	Skill Level	Warranty Time	Standard
(1) HUB & BEARING, R&R			
All Models (2WD)			
One Side	B	(0.8)	1
Both Sides	B	(1.5)	1.9

Parts

	Mfg. Part No.	Price (MSRP)*
HUB & BEARING		
All Models		
1/2 Ton		
w/Crew Cab	15946732	$509.50
w/o Crew Cab	15233111	$453.46

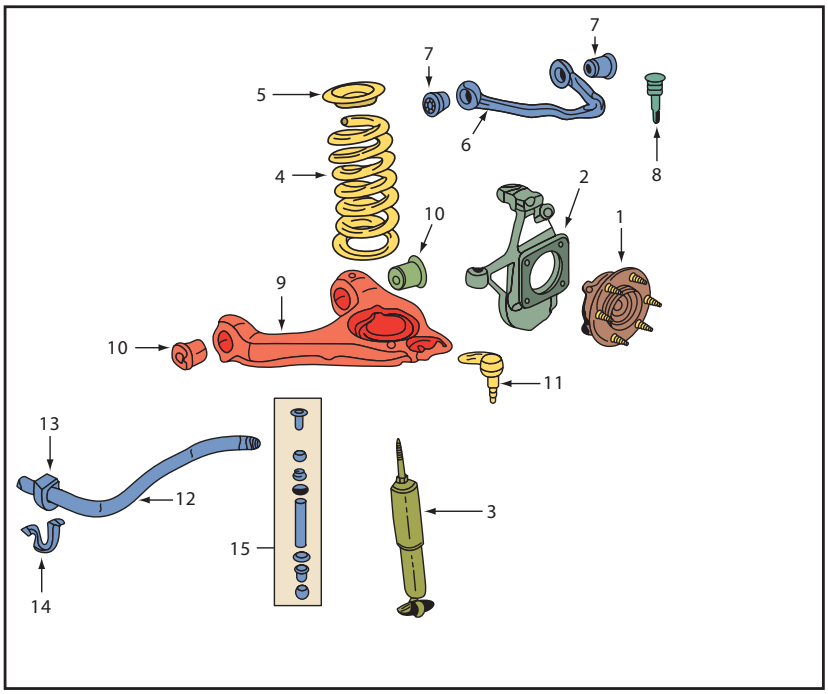


FIGURE 2–5 When you are paid flat-rate, you are paid for the times listed in a labor guide.

earns $22.50 each hour worked. However, if the technician turns in only 30 hours in the 40-hour week, the hourly pay is $11.25.

The flat-rate times from the manufacturers are also used for warranty repairs. Once a vehicle gets a little older, it takes a little longer to service it. This is because dirt, rust, and other conditions make the services more difficult. Because of this, the flat-rate times for older vehicles are longer. Because nondealership service facilities normally work on "out-of-warranty" vehicles, therefore older vehicles, the flat-rate times are about 20 percent higher than those for a newer vehicle.

At times, a flat-rate technician will be paid for the amount of time spent on the job. This is commonly referred to as "straight" or "clock" time. Straight time is paid when a service procedure is not listed in the flat-rate manual and when the customer's concern requires more than normal diagnostic time.

Team System The team system is a variation of the flat-rate system. The technicians on a team are paid according to the total hours the team completes. The team is comprised of A, B, and C technicians, their designations are based on their skill levels. There is normally one "A" tech who normally does advanced diagnostics. An A tech receives the highest compensation on the team. One or two "B" techs are also on the team. These are techs that can handle somewhat difficult diagnostics and most repairs. They are paid at a lower flat-rate wage than the A tech. There are also "C" techs and normally there are two. These techs are typically apprentices and are capable of doing normal services and minor repairs. As a technician's skills improve, they can move up the ladder and improve their pay.

To give an example of compensation, let's say a four-tech team turned in a total of 144 hours for the week. That means each tech will be paid for 36 hours. If the A tech was paid $15 per hour, his total compensation would be $540.00. The B tech earns $12 per hour and would earn $432.00 dollars for the week. The two C techs earn $9.00 per hour and each would make $324.00.

Benefits Along with the pay, the employer may offer benefits, sometimes called "fringe benefits." The cost of the benefits may be paid for by the business, or you may need to pay a share or all of the costs. There is no common benefit package for automotive technicians. Common benefits include:

- Health insurance
- Retirement plans
- Paid vacations
- Paid sick days
- Uniforms and uniform cleaning services
- Update training

When accepting employment, make sure you understand the benefits and seek help in choosing which you should participate in.

Total Earnings Depending on the business, you may be paid weekly, every two weeks, or twice a month. The total amount of what you earn is called your **gross pay**. This is not your "take home" or **net pay**. Your net pay is the result of subtracting all taxes and benefit costs from your gross pay. These deductions may include:

- Federal income taxes
- State income taxes
- City income taxes
- Federal Insurance Contribution Act (FICA) taxes—this is commonly known as social security taxes
- Your contribution toward health insurance
- Uniform costs

You should expect that your net pay will be approximately 70 percent of your gross pay. This means that if your gross pay for a week's work is $500.00, the amount you take home after deductions would be around $350.00. Of course that 70 percent number is a general rule; your actual net percentage may be higher or lower depending on many factors, such as where you live and work and if you have any deductions for dependents.

Working as a Technician

Once you have the job, you need to keep it. Your performance during the first few weeks will determine how long you will stay employed and how soon you will get a raise or a promotion. Make sure you arrive to work on time. If you are going to be late or absent, call the employer as soon as you can. Once you are at work:

- Be cheerful and cooperative with those around you.
- Do not spend talking or texting when you should be working.
- Find out what is expected of you and do your best to meet those expectations.

- Make sure you ask about anything you are not sure of, but try to think things out for yourself whenever you can.
- Show that you are willing to learn and to help out in emergencies.

A successful automotive technician has a good understanding of how the various automotive systems work, has good hand skills, has a desire to succeed, and has a commitment to be a good employee. The required training is not just in the automotive field. Because good technicians spend a great deal of time working with service manuals, good reading skills are a must. Technicians must also be able to accurately describe what is wrong to customers and the service advisor. Often these descriptions are done in writing; therefore, a technician also needs to be able to write well.

Employer-Employee Relationships

Being a good employee requires more than job skills. When you become an employee, you sell your time, skills, and efforts. In return, your employer has certain responsibilities:

- **Instruction and Supervision.** You should be told what is expected of you. Your work should be observed and you should be told if your work is satisfactory and offered ways to improve your performance.
- **Good Working Conditions.** An employer should provide a clean and safe work area as well as a place for personal cleanup.
- **Benefits.** When you were hired, you were told what fringe benefits you can expect. The employer should provide these when you are eligible to receive them.
- **Opportunity and Fair Treatment.** You should be given a chance to succeed and possibly advance within the company. You and all other employees should be treated equally, without prejudice or favoritism.

On the other side of this business relationship, you have responsibilities to the employer, including:

- **Regular Attendance.** A good employee is reliable. Businesses cannot operate successfully unless their workers are on the job.
- **Following Directions.** As an employee, you are part of a team. Doing things your way may not serve the best interests of the company.
- **Team Membership.** A good employee works well with others and strives to make the business successful.
- **Responsibility.** Be willing to answer for your behavior and work habits.
- **Productivity.** Remember that you are paid for your time as well as your skills and effort. You have a duty to be as effective as possible when you are at work.
- **Loyalty.** Loyalty is expected by any employer. This means you are expected to act in the best interests of your employer, both on and off the job.

Communications

Employers value employees who can communicate. Effective communications include listening, reading, speaking, and writing. Communication is a two-way process. The basics of communication are simply sending a message and receiving a response.

To be successful, you should carefully follow all oral and written directions that pertain to your job. If you do not fully understand them, ask for clarification. You also need to be a good listener. Like other things in life, messages can appear to be good, bad, or have little worth to you. Regardless of how you rate the message, you should show respect to the person giving the message. Look at the person while he or she is speaking and listen to the message before you respond. In order to totally understand the message, you may need to ask questions and gather as many details as possible. Do not try to control the conversation, and give listeners a chance to speak. *Hint:* Try to put yourself in the other person's shoes and listen without bias.

Obviously, when you read something, you are receiving a message without the advantage of seeing the message sender. Therefore, you must take what you read at face value. This is important because being able to read and understand the information and specifications given in service information is necessary for automotive technicians **(Figure 2–6)**.

Do your best to think through the words you use to convey a message to the customer or your supervisor. Pay attention to how they are listening and adjust your words and mannerisms accordingly. When writing a response, think about to whom the message is for and adjust your words to match their abilities and attitudes. Also, keep in mind that more

2012 4-cylinder Honda Accord Specifications

Item	Measurement	Qualification	Standard or New	Service Limit
Generator	Output	At 13.5 V and normal engine temperature	105 A	
	Coil (rotor) resistance	At 68 °F (20 °C)	3.4–3.8 Ω	
	Slip ring O.D.		14.4 mm (0.567 inches)	14.0 mm (0.551 inches)
	Brush length		10.5 mm (0.413 inches)	1.5 mm (0.059 inches)
Starter	Output		1.8 kW	
	Commutator mica depth		0.50–0.90 mm (0.0197–0.0354 inches)	0.20 mm (0.0079 inches)
	Commutator runout		0.02 mm (0.0008 inches) max.	0.05 mm (0.0020 inches)
	Commutator O.D.		28.9–29.0 mm (1.138–1.142 inches)	28.0 mm (1.102 inches)
	Brush length		15.0–16.0 mm (0.591–0.630 inches)	9.0 mm (0.354 inches)
	Brush spring tension		22.3–27.3 N (5.00–6.13 ft.-lb)	
Radiator cap	Opening pressure		93–123 kPa (13.5–17.8 psi)	
Engine oil	Capacity	Engine overhaul	5.1 L (5.4 US qt)	
		Oil change including filter	4.0 L (4.2 US qt)	
		Oil change without filter	3.8 L (4.0 US qt)	

FIGURE 2-6 Being able to read and understand the information and specifications given in service information is a must for automotive technicians.

than one person may read it, so think of others' needs as well.

Proper telephone etiquette is also important. Most businesses will tell you how to answer the phone, typically involving the name of the company followed by your name. Make sure you listen carefully to the person calling. When you are the one making the call, make sure you introduce yourself and state the purpose of the phone call. Again, the key to proper phone etiquette is respect.

Nonverbal Communication

In all communications, some of the true meaning is lost. In many cases, the heard message is often far different from the one intended. Because the words spoken are not always understood or are interpreted incorrectly because of personal feelings, you can alter the meaning of words significantly by changing the tone of your voice. Think of how many ways you can say "no"; you could express mild doubt, terror, amazement, anger, and other emotions.

It is important that you realize that a major part of communication is nonverbal. **Nonverbal communication** is the things you do while communicating. Pay attention to your nonverbal communication as well as to that of others.

Nonverbal communication includes such things as body language and tone. Body language includes facial expression, eye movement, posture, and gestures. All of us read people's faces; we interpret what they say or feel. We also look at posture to give us a glimpse of how the other person feels about the message. Posture can indicate self-confidence, aggressiveness, fear, guilt, or anxiety. Similarly, we

look at how they place their hands or give a handshake.

Many scholars have studied body language and have defined what certain behaviors indicate. Some divide postures into two basic groups:

- *Open/closed* is the most obvious. People with their arms folded, legs crossed, and bodies turned away are signaling that they are rejecting or are closed to messages, whereas people fully facing you with open hands and both feet planted on the ground are saying they are open to and accepting the message.
- *Forward/back* indicates whether people are actively or passively reacting to the message. When they are leaning forward and pointing toward you, they are actively accepting or rejecting the message. When they are leaning back, looking at the ceiling, doodling on a pad, or cleaning their glasses, they are either passively absorbing or ignoring the message.

Solving Problems and Critical Thinking

Anyone who can think critically and logically to evaluate situations is very desirable. **Critical thinking** is the art of being able to judge or evaluate something without bias or prejudice. When diagnosing a problem, critical thinkers are able to locate the cause of the problem by responding to what is known, not what is supposed.

Good critical thinkers begin solving problems by carefully observing what is and what is not happening. Based on these observations, something is declared as a fact. For example, if the right headlamp of a vehicle does not light and the left headlamp does, a critical thinker will be quite sure that the source of the problem is related to the right headlamp and not the left one. Therefore, all testing will be centered on the right headlamp. The critical thinker then studies the circuit and determines the test points. Prior to conducting any test, the critical thinker knows what to test and what the possible test results would indicate.

Critical thinkers solve problems in an orderly way and do not depend on chance. They come to conclusions based on a sound reasoning. They also understand that if a specific problem exists only during certain conditions, there are a limited number of causes. They further understand the relationship between how often the problem occurs and the probability of accurately predicting the problem. Also, they understand that one problem may cause other problems and they know how to identify the connection between the problems.

Solving problems is something we do every day. Often the problems are trivial, such as deciding what to watch on television. Other times they are critical and demand much thought. At these times, thinking critically will really pay off. Although it is impossible to guarantee that critical thinking will lead to the correct decision, it will lead to good decisions and solutions.

Diagnosis

The word **diagnosis** is used to define one of the major duties of a technician. Diagnosis is a way of looking at systems that are not functioning properly and finding out why. It is not guessing, and it is more than following a series of interrelated steps in order to find the solution to a specific problem. Solid diagnosis is based on an understanding of the purpose and operation of the system that is not working properly.

In service manuals, there are diagnostic aids given for many different problems. These are either symptom based or flow charts. **Flow charts** or decision trees **(Figure 2–7)** guide you through a step-by-step process. As you answer the questions given at each step, you are told what your next step should be. Symptom-based diagnostic charts **(Figure 2–8)** focus on a definition of the problem and offer a list of possible causes of the problem. Sometimes the diagnostic aids are a combination of the two—a flow chart based on clearly defined symptoms.

When these diagnostic aids are not available or prove to be ineffective, good technicians conduct a visual inspection and then take a logical approach **(Figure 2–9)** to finding the cause of the problem. This relies on critical thinking skills as well as system knowledge. Logical diagnosis follows these steps:

1. **Verify that the problem exists.** After interviewing the customer, take the vehicle for a road test and try to duplicate the problem, if possible.
2. **Do some preliminary checks.** Research all available information to determine the possible causes of the problem. Try to match the exact problem with a symptoms chart or think about what is happening and match a system or some components to the problem.