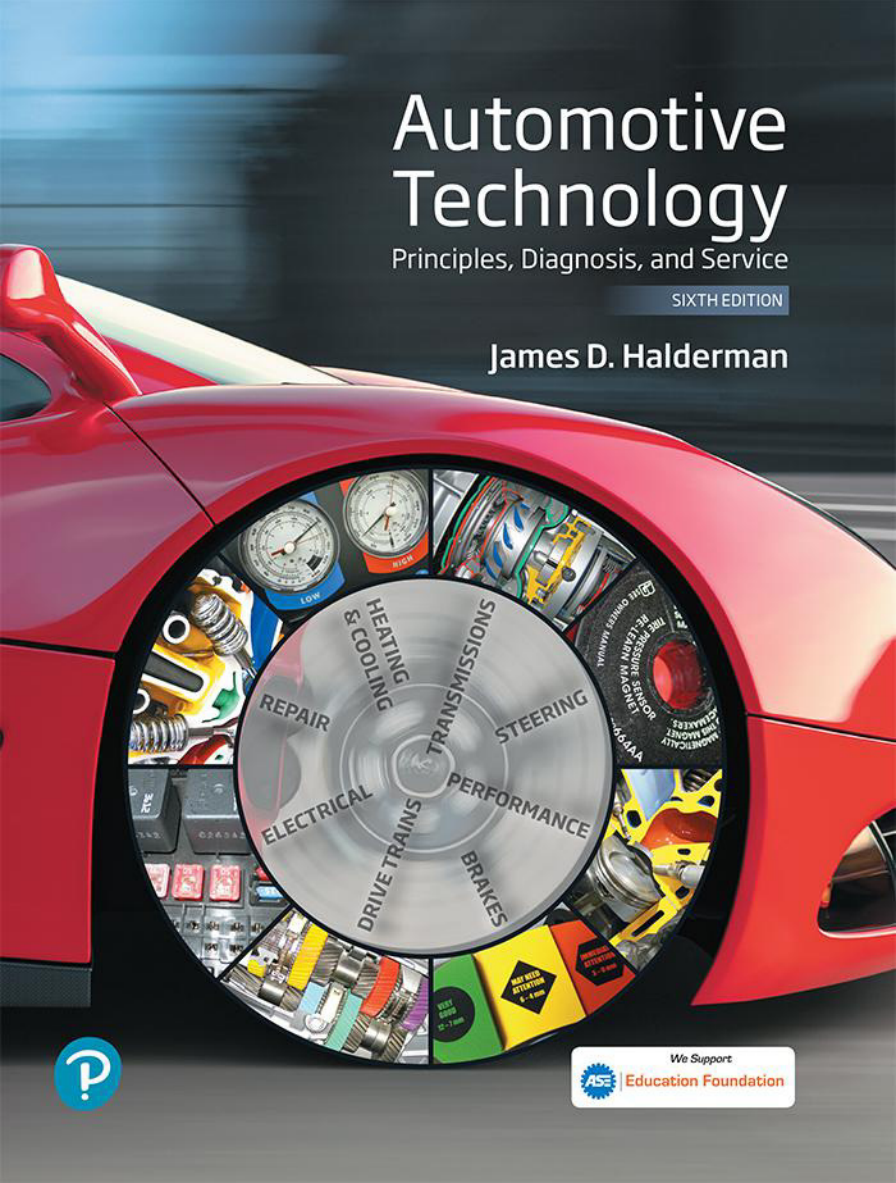
Automotive Technology

Principles, Diagnosis, and Service

SIXTH EDITION

James D. Halderman



AUTOMOTIVE TECHNOLOGY

Principles, Diagnosis, and Service

SIXTH EDITION

James D. Halderman

Pearson

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PREFACE

NEW TO THIS EDITION. Based on the suggestions and recommendations from automotive instructors and reviewers, the following changes have been made to the sixth edition:

- The number of chapters have been increased from 130 to 136 making it easier to select the exact content to study or teach. **The new chapters include**:
  - Chapter 58 - **Safety, Comfort, and Convenience Accessories**
  - Chapter 59 - **Security and Immobilizer Systems**
  - Chapter 61 -**Autonomous Vehicles- Operation and Service Procedures**
  - Chapter 64- **Air Management System**
  - Two new chapters were added under the hybrid vehicle section titled **Hybrid High-Voltage Batteries** (Chapter 92) and **Electric and Plug-in Hybrid Electric Vehicles** (Chapter 93).
  - The chapter on power steering was expanded and then split into two chapters: **Hydraulic Power Steering Systems** (Chapter 122) and **Electric Power Steering Systems** (Chapter 123).
  - A new chapter titled **Vibration and Noise Diagnosis and Correction** (Chapter 132) was added in response to instructor requests.
- Over 200 new full-color photos and line drawings to make the subject come alive.
- Updated throughout and correlated to the latest **ASE tasks**.
- New **Case Studies** included in this edition covering the "three Cs" (Complaint, Cause, and Correction).
- New OSHA hazardous chemical labeling requirements added to Chapter 7.
- New content on three-legged and low-profile fuses, plus smart junction boxes, added to Chapter 44.
- The chapter on brake principles (Chapter 97) has been expanded to include the details on brake friction materials, which are now in one location, instead of being repeated in the drum and disc brake chapters.
- Qualifying brake lathe information added to chapter 108.
- Additional content on snap-in and clamp-on TPMS sensors, plus updated relearn procedures, in chapter 114.
- Additional content on various wheel-weight material, plus wheel-flange information, added to the totally updated Chapter 115.
- Many new review and chapter quiz questions align to the new and updated content in each chapter.

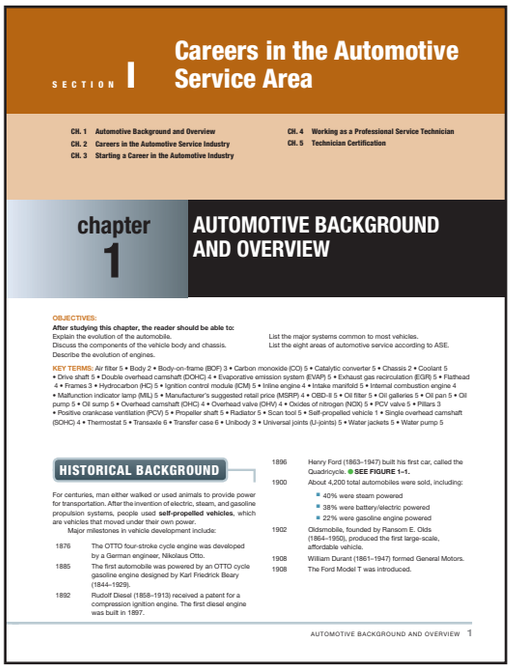
ASE CORRELATED This comprehensive textbook is divided into sections that correspond to the eight areas of certifications as specified by the National Institute for Automotive Service Excellence (ASE). All laboratory worksheets are correlated to the ASE Task Sheets.

A COMPLETE INSTRUCTOR AND STUDENT SUPPLEMENT PACKAGE Please see page xi for a detailed list of supplements.

A FOCUS ON DIAGNOSIS AND PROBLEM SOLVING The primary focus of this textbook is to satisfy the need for problem diagnosis. Time and again, the author has heard that technicians need more training in diagnostic procedures and skill development. To meet this need and to help illustrate how real problems are solved, diagnostic stories are included throughout. Each new topic covers the parts involved, as well as their purpose, function, and operation, and how to test and diagnose each system.

The following pages highlight the unique core features that set this book apart from other automotive textbooks.

IN-TEXT FEATURES



SECTION 1 Careers in the Automotive Service Area

CH. 1 Automotive Background and Overview
CH. 2 Careers in the Automotive Service Industry
CH. 3 Starting a Career in the Automotive Industry
CH. 4 Working as a Professional Service Technician
CH. 5 Technician Certification

chapter 1 AUTOMOTIVE BACKGROUND AND OVERVIEW

OBJECTIVES:
After studying this chapter, the reader should be able to:
Explain the evolution of the automobile.
Discuss the components of the vehicle body and chassis.
Describe the evolution of engines.
List the major systems common to most vehicles.
List the eight areas of automotive service according to ASE.

KEY TERMS: Air filter 5 • Body 2 • Body-on-frame (BOF) 3 • Carbon monoxide (CO) 5 • Catalytic converter 5 • Chassis 2 • Coolant 5 • Drive shaft 5 • Double overhead camshaft (DOHC) 4 • Evaporative emission system (EVAP) 5 • Exhaust gas recirculation (EGR) 5 • Flathead 4 • Frames 3 • Hydrocarbon (HC) 5 • Ignition control module (ICM) 5 • Inline engine 4 • Intake manifold 5 • Internal combustion engine 4 • Malfunction indicator lamp (MIL) 5 • Manufacturer's suggested retail price (MSRP) 4 • OBD-II 5 • Oil filter 5 • Oil galleries 5 • Oil pan 5 • Oil pump 5 • Oil sump 5 • Overhead camshaft (OHC) 4 • Overhead valve (OHV) 4 • Oxides of nitrogen (NOX) 5 • PCV valve 5 • Pillars 3 • Positive crankcase ventilation (PCV) 5 • Propeller shaft 5 • Radiator 5 • Scan tool 5 • Self-propelled vehicle 1 • Single overhead camshaft (SOHC) 4 • Thermostat 5 • Transaxle 6 • Transfer case 6 • Unibody 3 • Universal joints (U-joints) 5 • Water jackets 5 • Water pump 5

HISTORICAL BACKGROUND

For centuries, man either walked or used animals to provide power for transportation. After the invention of electric, steam, and gasoline propulsion systems, people used **self-propelled vehicles**, which are vehicles that moved under their own power.

Major milestones in vehicle development include:

1876 The OTTO four-stroke cycle engine was developed by a German engineer, Nikolaus Otto.
1885 The first automobile was powered by an OTTO cycle gasoline engine designed by Karl Friedrick Bsary (1844–1929).
1892 Rudolf Diesel (1858–1913) received a patent for a compression ignition engine. The first diesel engine was built in 1897.
1896 Henry Ford (1863–1947) built his first car, called the Quadricycle. ● SEE FIGURE 1–1.
1900 About 4,200 total automobiles were sold, including:
- 40% were steam powered
- 38% were battery/electric powered
- 22% were gasoline engine powered

1902 Oldsmobile, founded by Ransom E. Olds (1864–1950), produced the first large-scale, affordable vehicle.
1908 William Durant (1861–1947) formed General Motors.
1908 The Ford Model T was introduced.

AUTOMOTIVE BACKGROUND AND OVERVIEW 1

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

TECH TIP

Right to TIghten

Whenever removing any automotive component, it is wise to screw the bolts back into the holes a couple of threads by hand. This ensures that the right bolt is used in its original location.

TECH TIP feature real-world advice and "tricks of the trade" from ASE-certified master technicians.

SAFETY TIP

Shop Cloth Disposal

Always dispose of oily shop cloths in an enclosed container to prevent a fire. ● **SEE FIGURE 1–69.** Whenever oily cloths are thrown together on the floor or workbench, a chemical reaction can occur, which can ignite the cloth, even without an open flame. This process of ignition without an open flame is called **spontaneous combustion**.

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

REAL WORLD FIX

Lightning Damage

A radio failed to work in a vehicle that was outside during a thunderstorm. The technician checked the fuses and verified that power was reaching the radio. Then the technician noticed the antenna. It had been struck by lightning. Obviously, the high voltage from the lightning strike traveled to the radio receiver and damaged the circuits. Both the radio and the antenna were replaced to correct the problem. ● **SEE FIGURE 26–26.**

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

CASE STUDY

Real World Fixes

Present students with actual automotive service scenarios and show how these common (and sometimes uncommon) problems were diagnosed and repaired. Each case study includes the "Three Cs" (Complaint, Cause and Correction)

CASE STUDY present students with actual automotive scenarios and show how these common (and sometimes uncommon) problems were diagnosed and repaired.

FREQUENTLY ASKED QUESTION

What Is an "SST?"

Vehicle manufacturers often specify a **special service tool (SST)** to properly disassemble and assemble components, such as transmissions and other components. These tools are also called special tools and are available from the vehicle manufacturer or their tool supplier, such as Kent-Moore and Miller tools.

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

NOTE: Most of these "locking nuts" are grouped together and are commonly referred to as *revailing torque nuts.* This means that the nut holds its tightness or torque and does not loosen with movement or vibration.

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

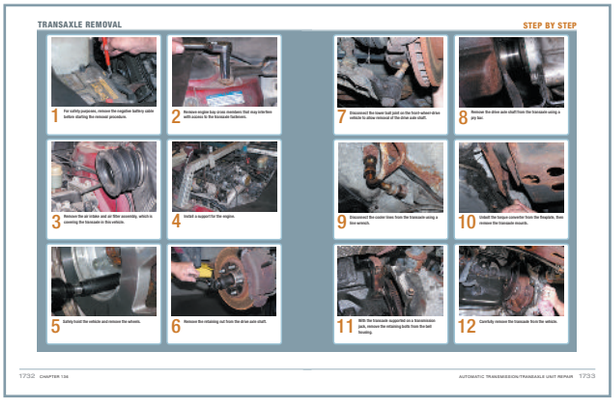
CAUTION: Never use hardware store (nongraded) bolts, studs, or nuts on any vehicle steering, suspension, or brake component. Always use the exact size and grade of hardware that is specified and used by the vehicle manufacturer.

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

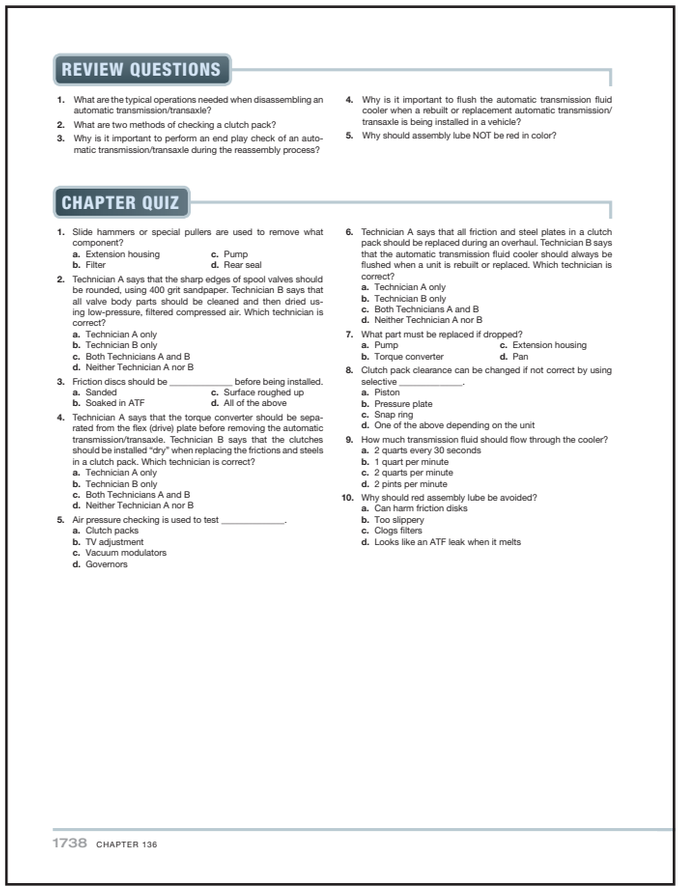
WARNING

Do not use incandescent trouble lights around gasoline or other flammable liquids. The liquids can cause the bulb to break and the hot filament can ignite the flammable liquid, which can cause personal injury, or even death.

WARNINGS alert students to potential dangers to themselves during a specific task or service procedure.



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



REVIEW QUESTIONS

1. What are the typical operations needed when disassembling an automatic transmission/transaxle?
2. What are two methods of checking a clutch pack?
3. Why is it important to perform an end play check of an automatic transmission/transaxle during the reassembly process?
4. Why is it important to flush the automatic transmission fluid cooler when a rebuilt or replacement automatic transmission/transaxle is being installed in a vehicle?
5. Why should assembly lube NOT be red in color?

CHAPTER QUIZ

1. Slide hammers or special pullers are used to remove what component?
   a. Extension housing
   b. Filter
   c. Pump
   d. Rear seal
2. Technician A says that the sharp edges of spool valves should be rounded, using 400 grit sandpaper. Technician B says that all valve body parts should be cleaned and then dried using low-pressure, filtered compressed air. Which technician is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technicians A and B
   d. Neither Technician A nor B
3. Friction discs should be _____ before being installed.
   a. Sanded
   b. Soaked in ATF
   c. Surface roughed up
   d. All of the above
4. Technician A says that the torque converter should be separated from the flex (drive) plate before removing the automatic transmission/transaxle. Technician B says that the clutches should be installed "dry" when replacing the frictions and steels in a clutch pack. Which technician is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technicians A and B
   d. Neither Technician A nor B
5. Air pressure checking is used to test _____.
   a. Clutch packs
   b. TV adjustment
   c. Vacuum modulators
   d. Governors
6. Technician A says that all friction and steel plates in a clutch pack should be replaced during an overhaul. Technician B says that the automatic transmission fluid cooler should always be flushed when a unit is rebuilt or replaced. Which technician is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technicians A and B
   d. Neither Technician A nor B
7. What part must be replaced if dropped?
   a. Pump
   b. Torque converter
   c. Extension housing
   d. Pan
8. Clutch pack clearance can be changed if not correct by using selective _____.
   a. Piston
   b. Pressure plate
   c. Snap ring
   d. One of the above depending on the unit
9. How much transmission fluid should flow through the cooler?
   a. 2 quarts every 30 seconds
   b. 1 quart per minute
   c. 2 quarts per minute
   d. 2 pints per minute
10. Why should red assembly lube be avoided?
    a. Can harm friction disks
    b. Too slippery
    c. Clogs filters
    d. Looks like an ATF leak when it melts

1738 CHAPTER 136

THE REVIEW QUESTIONS AND CHAPTER QUIZ at the end of each chapter help students review the material presented in the chapter and test themselves to see how much they've learned.

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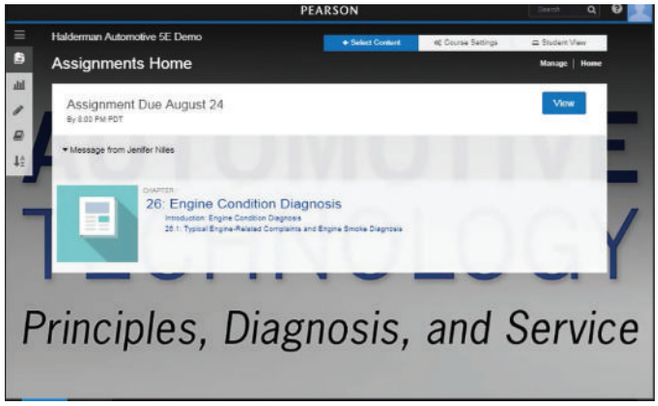
With *Revel Automotive Technology 6E*, students will be engaged in the content by *reading* and *doing*. Videos with questions, case studies, interactive activities, flashcards, and end of chapter quizzes engage students and enhance their understanding of core topics as they progress through the content. Instructors can also assign ASE Task Sheets for students to complete while they are in the shop and then submit through Revel for grading.

- **Step-by-Step Photo Sequences** show in detail the steps involved in performing a specific task or service procedure
- **Task Sheets for each ASE Objective** are included with the applicable chapter and are submitted digitally for instructor grading!
- **Videos** demonstrate or expand on key ASE procedures and concepts. Each video includes Check Your Understanding questions to ensure students understand the material.
- **Interactive activities** allow students to check their understanding through parts identification, labeling, matching, and other engaging activities.
- **Case Studies** provide a real world scenario to challenge students to think critically about and determine the Complaint, Cause, and Correction
- **Flashcards** review chapter key terms to ensure students know the important terminology before moving ahead.
- **End of Chapter Quiz** provide an assessment of chapter objectives to ensure students are mastering the content.
- **Notes and Highlighting** allow you and your students to easily take notes and mark what is important for easy review later.



PERFORMANCE DASHBOARD Revel includes a Performance Dashboard that enables you to view assignment completion, time on task, answers to short- answer assignments, how the class is trending, and student performance by learning outcome.

This view allows you to view average performance for your class. You can view average time on task for each chapter section and quiz, as well as the scores for each quiz.

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SUPPLEMENTS

RESOURCES IN PRINT AND ONLINE
Automotive Technology

NAME OF SUPPLEMENT	PRINT	ONLINE	AUDIENCE	DESCRIPTION
Instructor Resource Manual 013525745X		✔	Instructors	NEW! The Ultimate teaching aid: Chapter summaries, key terms, chapter learning objectives, and lecture resources.
TestGen 0135257999		✔	Instructors	Test generation software and test bank for the text.
PowerPoint Presentation 0135257409		✔	Instructors	Slides include a lecture outline of the text to help instructors with in class instruction.
Image Bank 0135257433		✔	Instructors	All of the images from the textbook to create customized slides.
ASE Task Sheets – for instructors 0135257638		✔	Instructors	Downloadable ASE task sheets for easy customization.
ASE Task Sheets – for Students 0135257417	✔		Students	Student's can purchase a study activity manual that correlates ASE Automobile Standards to chapters and page numbers in the text.
VitalSource eBook 0135257492		✔	Students	An alternative to purchasing the print textbook, students can save up to 50% off the suggested list price of the print text. Visit **www.vitalsource.com**

All online resources can be downloaded from the Instructor's Resource Center: **www.pearsonhighered.com** *Search for your specific title there and select the Resources.*

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Accurate, while maintaining the easy-to-read style that has made other books from the same author so popular.

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SECTION I

Careers in the Automotive Service Area

CH. 1 Automotive Background and Overview
CH. 2 Careers in the Automotive Service Industry
CH. 3 Starting a Career in the Automotive Industry
CH. 4 Working as a Professional Service Technician
CH. 5 Technician Certification

chapter 1

AUTOMOTIVE BACKGROUND AND OVERVIEW

LEARNING OBJECTIVES:

After studying this chapter, the reader should be able to:

Explain the evolution of the automobile.
Discuss the components of the vehicle body and chassis.
Describe the evolution of engines.
List the major systems common to most vehicles.
List the eight areas of automotive service according to ASE.

KEY TERMS: Air filter 5 • Body 2 • Body-on-frame (BOF) 3 • Carbon monoxide (CO) 5 • Catalytic converter 5 • Chassis 2 • Coolant 5 • Drive shaft 5 • Double overhead camshaft (DOHC) 4 • Evaporative emission system (EVAP) 5 • Exhaust gas recirculation (EGR) 5 • Flathead 4 • Frames 3 • Hydrocarbon (HC) 5 • Ignition control module (ICM) 5 • Inline engine 4 • Intake manifold 5 • Internal combustion engine 4 • Malfunction indicator lamp (MIL) 5 • Manufacturer's suggested retail price (MSRP) 4 • OBD-II 5 • Oil filter 5 • Oil galleries 5 • Oil pan 5 • Oil pump 5 • Oil sump 5 • Overhead camshaft (OHC) 4 • Overhead valve (OHV) 4 • Oxides of nitrogen (NOX) 5 • PCV valve 5 • Pillars 3 • Positive crankcase ventilation (PCV) 5 • Propeller shaft 5 • Radiator 5 • Scan tool 5 • Self-propelled vehicle 1 • Single overhead camshaft (SOHC) 4 • Thermostat 5 • Transaxle 6 • Transfer case 6 • Unibody 3 • Universal joints (U-joints) 5 • Water jackets 5 • Water pump 5

HISTORICAL BACKGROUND

For centuries, man either walked or used animals to provide power for transportation. After the invention of electric, steam, and gasoline propulsion systems, people used **self-propelled vehicles**, which are vehicles that moved under their own power.

Major milestones in vehicle development include:

1876 The OTTO four-stroke cycle engine was developed by a German engineer, Nikolaus Otto.

1885 The first automobile was powered by an OTTO cycle gasoline engine designed by Karl Friedrick Benz (1844–1929).

1892 Rudolf Diesel (1858–1913) received a patent for a compression ignition engine. The first diesel engine was built in 1897.

1896 Henry Ford (1863–1947) built his first car, called the Quadricycle. ● **SEE FIGURE 1–1.**

1900 About 4,200 total automobiles were sold, including:

- 40% were steam powered
- 38% were battery/electric powered
- 22% were gasoline engine powered

1902 Oldsmobile, founded by Ransom E. Olds (1864–1950), produced the first large-scale, affordable vehicle.

1908 William Durant (1861–1947) formed General Motors.

1908 The Ford Model T was introduced.

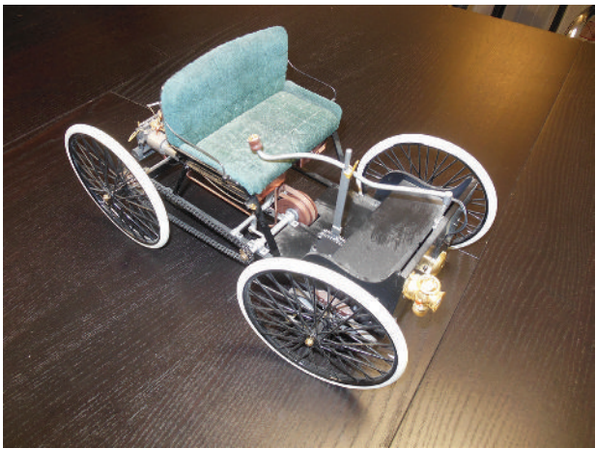


FIGURE 1–1 A model of the Quadricycle, a car built by Henry Ford in 1896.

FIGURE 1–2 Most vehicle bodies were constructed with a wood framework until the 1920s.

1912	The electric starter was invented by Charles F. Kettering (1876–1958) of Dayton, Ohio, first used on a Cadillac. The starter was produced by a new company called Delco, which stood for Dayton Engineering Laboratories Company.
1914	First car with a 100% steel body was made by the Budd Corporation for Dodge. Before 1914, all car bodies had wood components in them.
1922	The first vehicle to have four-wheel hydraulically operated brakes was a Duesenberg built in Indianapolis, Indiana.
1940	The first fully automatic transmission was introduced by Oldsmobile.
1973	Airbags were offered as an option on some General Motors vehicles.
1985	Lincoln offers the first four-wheel antilock braking system.
1997	The first vehicle with electronic stability control was offered by Cadillac.

BODIES

Early motor vehicles evolved from horse-drawn carriages. The engine and power train were attached to a modified carriage leading to the term "horseless carriage." ● **SEE FIGURE 1–2.**

The bodies evolved until in the 1930s, all-steel-enclosed bodies became the most used type. All bodies depended on a frame of wood or steel to support the chassis components.

CHASSIS SYSTEMS OVERVIEW

The **chassis** system of the vehicle includes the following components:

1. Frame or **body** of the vehicle, which is used to provide the support for the suspension and steering components as well as the powertrain.
2. The suspension system of the vehicle provides a smooth ride to the driver and passengers and helps the tires remain on the road even when the vehicle is traveling over rough roads. The suspension system includes springs and control arms that allow the wheel to move up and down and keep the tires on the road.

FIGURE 1–3 A chassis of a 1950s era vehicle showing the engine, drivetrain, frame, and suspension.

3. The braking system of the vehicle is used to slow and stop the rotation of the wheels, which in turn stops the vehicle. The braking system includes the brake pedal, master cylinder, plus wheel brakes at each wheel. Two types of wheel brakes are used. Disc brakes include a caliper, which applies force to brake pads on both sides of a rotating disc or rotor. Drum brakes use brake shoes, which are applied by hydraulic pressure outward against a rotating brake drum. The brake drum is attached to and stops the rotation of the wheels. Drum brakes are often used on the rear of most vehicles.
4. Wheels and tires—The wheels are attached to the bearing hubs on the axles. The tires must provide traction for accelerating, braking, and cornering, as well as provide a comfortable ride. Wheels are constructed of steel or aluminum alloy and mount to the hubs of the vehicle using lug nuts, which must be tightened correctly to the proper torque.

The chassis components include:

- Front and rear suspension
- Axles and hubs (to support the wheels and tires)
- Steering mechanism
- Engine and transmission
- Final drive differential and axles

Often, these chassis were so complete that they could be driven without a body. ● **FIGURE 1–3.**

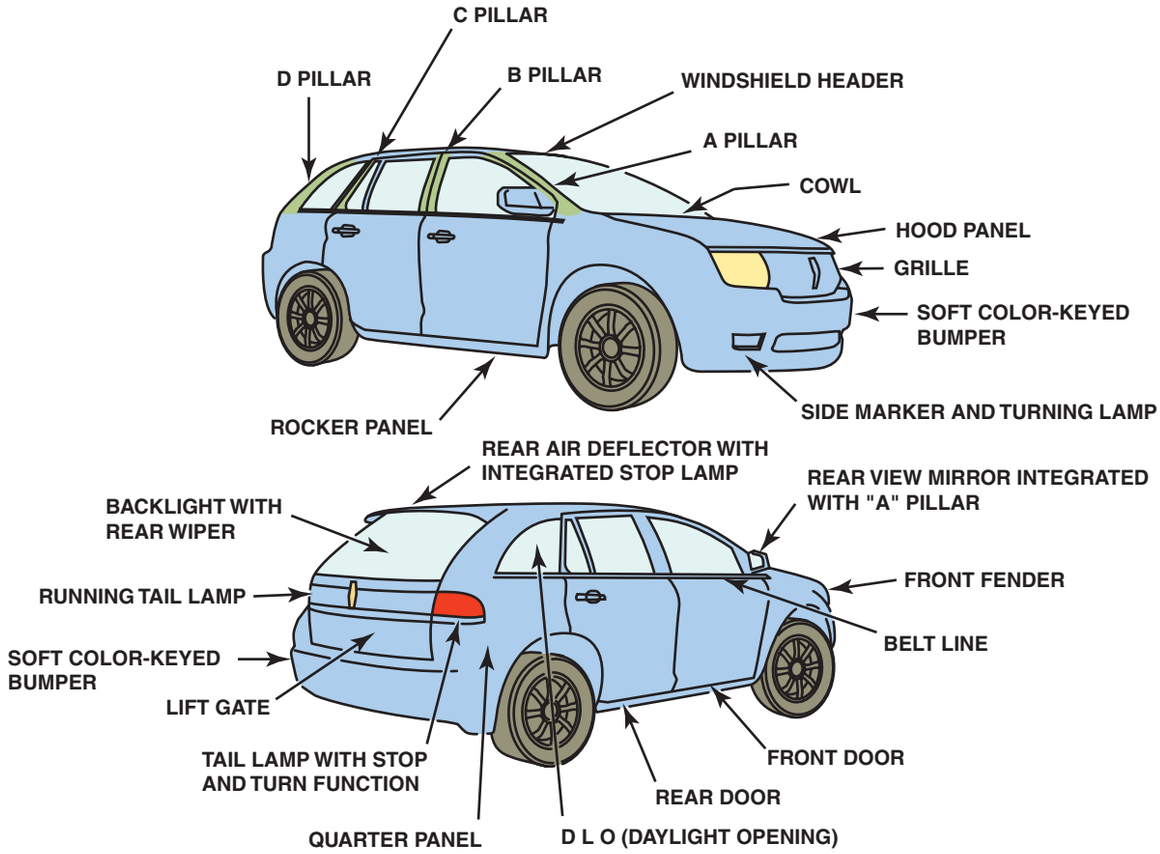


FIGURE 1–4 Body and terms.

Many of the expensive automakers in the 1920s and 1930s had bodies built by another company. Eventually, most bodies were constructed of steel and many without the need for a frame to support the drivetrain and suspension.

BODY TERMS The roof of a vehicle is supported by **pillars** and they are labeled A, B, C, and D from the front to the rear of the vehicle. All vehicles have an A pillar at the windshield but many, such as a hardtop, do not have a B pillar. Station wagons and sport utility vehicles (SUVs) often have a D pillar at the rear of the vehicle. ● **SEE FIGURE 1–4.**

FRAMES

Frame construction usually consists of channel-shaped steel beams welded and/or fastened together. Vehicles with a separate frame and body are usually called **body-on-frame (BOF)** vehicles**.** Many terms are used to label or describe the frame of a vehicle including:

UNIT-BODY CONSTRUCTION Unit-body construction (sometimes called **unibody**) is a design that combines the body with the structure of the frame. The body is composed of many individual stamped-steel panels welded together. The strength of this type of construction lies in the *shape* of the assembly. The typical vehicle uses 300 separate stamped-steel panels that are spot-welded together to form a vehicle's body. ● **SEE FIGURE 1–5.**

NOTE: A typical vehicle contains about 10,000 separate individual parts.

FIGURE 1–5 Note the ribbing and the many different pieces of sheet metal used in the construction of this body.

TECH TIP

Treat a Vehicle Body with Respect

Do not sit on a vehicle. The metal can easily be distorted, which could cost hundreds of dollars to repair. This includes sitting on the hood, roof, and deck (trunk) lid, as well as fenders. Also, do not hang on any opened door as this can distort the hinge area causing the door not to close properly.

FIGURE 1–6 A Corvette without the body. Notice that the vehicle is complete enough to be driven. This photo was taken at the Corvette Museum in Bowling Green, Kentucky.

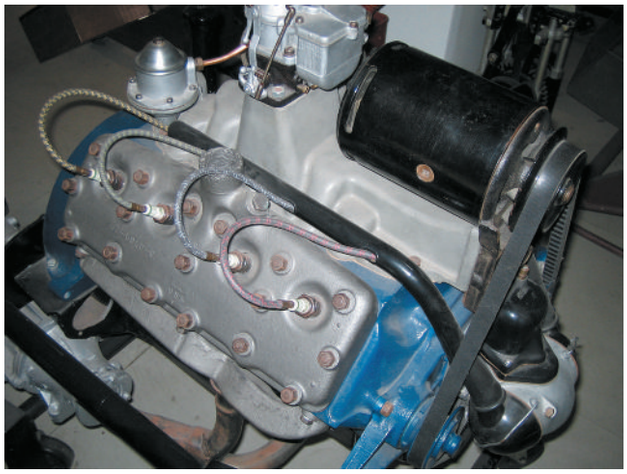


FIGURE 1–7 A Ford flathead V-8 engine. This engine design was used by Ford Motor Company from 1932 through 1953. In a flathead design, the valves are located next to (beside) the cylinders.

SPACE-FRAME CONSTRUCTION Space-frame construction consists of formed sheet steel used to construct a framework of the entire vehicle. The vehicle is drivable without the body, which uses plastic or steel panels to cover the steel framework. ● **SEE FIGURE 1–6.**

ENGINE DESIGN EVOLUTION

All gasoline and diesel engines are called **internal combustion engines** and are designed to compress an ignitable mixture. This mixture is ignited by using a spark (gasoline) or by heat of compression (diesel). Early engines used valves that were in the engine block, which also contained the round cylinders where pistons were fitted. The pistons were connected to a crankshaft, which converted the up and down motion of the pistons to a rotary force that was used to propel the vehicle.

FIGURE 1–8 A Monroney label as shown on the side window of a new vehicle.

INLINE VERSUS V-TYPE DESIGN Most early engines used four or six cylinders arranged inline. These are called **inline engines** and are still produced today. Some engines with 4, 6, 8, 10, 12, or 16 cylinders are arranged with half of the cylinders on each set of a "V" and connected to a common crankshaft in the bottom of the "V." The crankshaft changed the up-and-down motion of the piston to rotary motion, allowing the engine to power the drive wheels.

VALVE LOCATION DESIGN The design where the valves are located in the engine block is called **flathead** design because the cylinder head simply covers the combustion chamber and includes a hole for the spark plug. The engine block contains passages for coolant, as well as lubricating oil and is the support for all other engine systems. ● **SEE FIGURE 1–7.**

By the 1950s, most engine designs placed the valves in the cylinder head. This is called an **overhead valve** *or* **OHV** design.

Even newer engine designs feature **overhead camshafts (OHC)**, called **single overhead camshaft (SOHC)** designs and engines that use two overhead camshafts per bank of cylinders called **double overhead camshaft (DOHC)** designs. The placement of the camshaft results in better flow of intake air into and exhaust out of the engine.

? **FREQUENTLY ASKED QUESTION**

What Is the Monroney Label?

The Monroney label is the sticker on the vehicle that lists the **manufacturer's suggested retail price**, usually abbreviated **MSRP.** The law that requires this label on all vehicles is called the Monroney Law, named for the congressman who sponsored the bill, Almer S. Monroney (1902–1980), a U.S. farm representative from Oklahoma from 1939 to 1951 and a U.S. Senator from 1951 to 1969.

Before the Monroney label law was passed in 1958, the price of a vehicle was unknown to new vehicle buyers who had to rely on the dealer for pricing. Besides all of the standard and optional equipment on the vehicle, the Monroney label also includes fuel economy and exhaust emission information. ● **SEE FIGURE 1–8.**

The need for reduced emissions and greater fuel economy led to advances in engine design. These changes include:

- Electronic ignition systems
- Electronic fuel injection
- Computerized engine controls
- Emission control devices, including the catalytic converter used in the exhaust system to reduce emissions
- Improved engine oils that help reduce friction and reduce emissions

ENGINE SYSTEMS OVERVIEW

Every engine requires many systems to function correctly.

COOLING SYSTEM While some older engines were air cooled, all engines currently in production are liquid cooled. Coolant is circulated by a **water pump** through passages in the cylinder block and head called **water jackets**. The **coolant** is a mixture of antifreeze and water to provide corrosion and freezing protection. After the coolant picks up the heat from the engine, it flows through a **radiator**, which cools the coolant by releasing the heat into the air. The temperature of the coolant is maintained by using a **thermostat** located in the coolant passage, which opens to allow coolant to flow to the radiator or closes until the coolant is hot enough to need cooling.

LUBRICATION SYSTEM All engines need a supply of lubricating oil to reduce friction and help to cool the engine. Most engines are equipped with an **oil pan**, also called an **oil sump**, containing 3 to 7 quarts (liters) of oil. An engine-driven **oil pump** forces the oil under pressure through an **oil filter**, then to passages in the block and head called **oil galleries**, and then to all of the moving parts.

AIR INTAKE SYSTEM All engines, both gasoline and diesel engines, draw air from the atmosphere. It requires about 9,000 gallons of air for each gallon of gasoline used. The air must be drawn where deep water in the road cannot be drawn into the engine. The air is then filtered by a replaceable **air filter**. After the air is filtered, it passes through a throttle valve and then into the engine through an **intake manifold**.

FUEL SYSTEM The fuel system includes the following components and systems:

- Fuel tank
- Fuel lines and filter(s)
- Fuel injectors
- Electronic control of the fuel pump and fuel injection

The fuel injectors are designed to atomize the liquid gasoline into small droplets so they can be mixed with the air entering the engine. This mixture of fuel and air is then ignited by the spark plug.

STARTING AND CHARGING SYSTEM Engine starting and charging systems include the battery, starting (cranking) system, charging system components, and circuits.

IGNITION SYSTEM The ignition system includes the ignition coil(s), after coil which creates a high voltage spark by stepping up battery voltage using an **ignition control module (ICM)**. The arc across the electrodes of the spark plug ignites the air-fuel mixture in the combustion chamber and the resulting pressure pushes the piston down on the power stroke.

EMISSION CONTROL SYSTEM The control of vehicle emissions includes controlling gasoline vapors from being released into the atmosphere in addition to reducing the emissions from the exhaust. Unburned gasoline emissions, called **hydrocarbon (HC)** emissions and exhaust gases, that are controlled include **carbon monoxide (CO)** and **oxides of nitrogen (NO**X**)**. The **evaporative emission control system**, usually called the **EVAP system,** is designed to prevent gasoline fumes and vapors from being released. Other emission control systems include:

- **Positive crankcase ventilation (PCV).** This system uses a valve called a **PCV valve** to regulate the flow of gases created in the crankcase of a running engine, which are routed back into the intake manifold. The engine will then draw these gases into the combustion chamber where they are burned to help prevent the release of the gases into the atmosphere.
- **Exhaust gas recirculation (EGR).** The EGR system meters about 3% to 7% of the exhaust gases back into the intake where the gases reduce the peak combustion temperature and prevent the oxygen (O_2) and nitrogen (NO) from the air from combining to form oxides of nitrogen.
- **Catalytic converter.** The catalytic converter is a unit located in the exhaust system usually close to the engine, which causes chemical changes in the exhaust gases.
- **On-board diagnostics.** This means that the engine, as well as the engine management systems can test itself, for proper operation and alert the driver if a fault is detected. The warning lamp is called the **malfunction indicator light (MIL)** and is labeled “Check Engine” or “Service Engine Soon.” The on-board diagnostic system is currently in the second generation and is called **OBD-II**. Electronic hand-held testers, called **scan tools**, are needed to access (retrieve) stored diagnostic trouble codes (DTCs) and view sensor and system data.

POWERTRAIN OVERVIEW

The purpose of the powertrain is to transfer the torque output of the engine to the drive wheels.

REAR-WHEEL-DRIVE POWERTRAIN A rear-wheel-drive vehicle uses the following components to transfer engine torque to the rear drive wheels:

- **Transmission.** An automatic transmission usually uses planetary gearsets and electronic controls to change gear ratios. In a manually shifted transmission, the drivetrain contains a clutch assembly, which allows the driver to disengage engine torque from the transmission to allow the driver to shift from one gear ratio to another. The transmission contains gears and other assemblies that provide high torque output at low speeds for acceleration and lower torque output but at higher speeds for maximum fuel economy at highway speeds.
- **Drive Shaft.** A **drive shaft**, also called a **propeller shaft**, is used to connect and transmit engine torque from the transmission to the rear differential. **Universal joints (U-joints)** are used to allow the rear differential to move up and down on the rear suspension and still be able to transmit engine torque.

FIGURE 1–9 A dash control panel used by the driver to control the four-wheel-drive system.

FIGURE 1–10 The alternator is responsible for supplying the electrical needs of the vehicle and to keep the battery charged.

- **Differential.** A differential is used at the rear of the vehicle and performs three functions:
  - The differential allows different axle speeds for cornering.
  - The differential increases the torque applied to the rear drive wheels by reducing the speed.
  - The differential also changes the direction of the applied engine torque and uses axle shafts to transfer the torque to the drive wheels.

FRONT-WHEEL-DRIVE POWERTRAIN A front-wheel-drive vehicle uses a **transaxle**, which is a combination of a transmission and differential in one assembly. Drive axle shafts then transfer the engine torque to the front drive wheels from the output of the transaxle.

FOUR-WHEEL-DRIVE SYSTEM There are many types of methods of powering all four wheels. Many include a **transfer case** to split engine torque to both the front and the rear wheels. ● **SEE FIGURE 1–9.**

ELECTRICAL/ELECTRONIC SYSTEMS OVERVIEW

Early vehicles did not have an electrical system because even the ignition did not require a battery. Early engines used a magnet to create a spark instead of using electrical power from a battery as used today.

The first electrical components on vehicles were battery-powered lights, not only for the driver to see the road, but also so others could see an approaching vehicle at night.

Only after 1912 and the invention of the self-starter did the use of a battery become commonplace. Charles F. Kettering also invented the point-type ignition system about the same time as the self-starter. Therefore, the early batteries were often referred to as SLI batteries, meaning starting, lighting, and ignition. From the 1920s into the 1950s other electrical components were added, such as radios, defroster fans, and horns. It was not until the 1960s that electrical accessories, such as air conditioning, power seats, and power windows, became common.

Today's vehicles require alternators that are capable of producing a higher amount of electricity than was needed in the past, and the number of electronic components has grown to include every system in the vehicle, including:

- A tire pressure monitoring system for the tires
- Heated and cooled seats
- Automatic climate control
- Power windows
- Security systems
- Electric power steering
- Electronic suspension

● **SEE FIGURE 1–10.**

HEATING, VENTILATION, AND AIR CONDITIONING OVERVIEW

Early model vehicles did not include heaters or other methods to provide comfort for the driver and passengers. Most early vehicles were open with a simple removable top. Some had optional side curtains that provided all-weather protection. In the 1930s and 1940s when fully enclosed bodies became common, the vehicle manufacturers started to include heaters, which were small radiators with engine coolant flowing through them. About the same time and into the 1950s, the only options that many vehicles had were a radio and heater, abbreviated R & H.

Today, air-conditioning systems are on most vehicles and incorporate defrosters and passenger compartment heating, often in two zones for maximum comfort of the driver and passenger. Additional related comfort options today include heated and cooled seats, and heated steering wheels.

EIGHT AREAS OF AUTOMOTIVE SERVICE

In 1972, the National Institute for Automotive Service Excellence, a nonprofit organization known as simply ASE, created a series of eight tests that cover the major vehicle systems. ● **SEE FIGURE 1–11.**

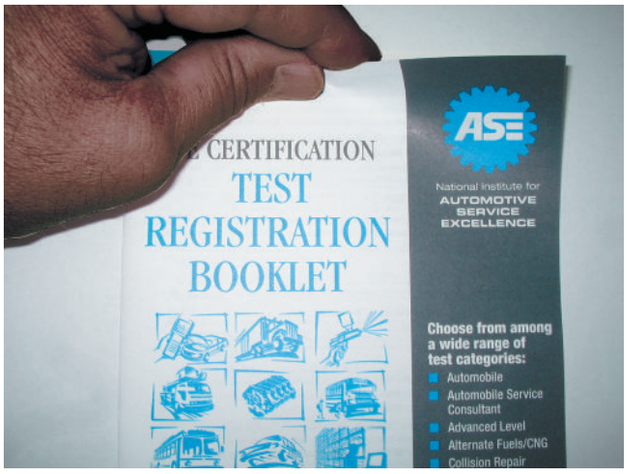


FIGURE 1–11 Test registration booklet that includes details on all vehicle-related certification tests given by ASE. All testing is now done electronically at proctored locations.

ENGINE REPAIR (A1) This content area includes questions related to engine block and cylinder head diagnosis and service, as well as the lubrication, cooling, fuel, ignition, and exhaust systems inspection and service.

AUTOMATIC TRANSMISSION (A2) This content area includes general automatic transmission/transaxle diagnosis, including hydraulic and electronic related systems.

MANUAL DRIVE TRAIN AND AXLES (A3) This content area includes clutch diagnosis and repair, manual transmission diagnosis and repair, as well as drive shaft, universal, and constant velocity joint diagnosis and service. Also included in this content area are rear differential diagnosis and repair, plus four-wheel-drive component diagnosis and repair.

SUSPENSION AND STEERING (A4) This content area includes steering and suspension system diagnosis and repair, including wheel alignment diagnosis and adjustments, plus wheel and tire diagnosis and repair procedures.

BRAKES (A5) The brake content area includes the diagnosis and repair of the hydraulic system, drum and disc brake systems, plus power assist units, antilock braking, and traction control systems.

ELECTRICAL/ELECTRONIC SYSTEMS (A6) This content area includes many systems, including the battery, starting, charging, lighting, gauges, and accessory circuit diagnosis and repair.

HEATING AND AIR CONDITIONING (A7) The heating and air-conditioning content area includes air-conditioning service, refrigeration systems, heating and engine cooling systems diagnosis and repair, as well as refrigerant recovery, recycling, handling, and retrofit.

ENGINE PERFORMANCE (A8) The engine performance content area includes diagnosis and testing of those systems responsible for the proper running and operation of the engine. Included in this area are general engine diagnosis and ignition and fuel systems, as well as emission control and computerized engine control diagnosis and repair.

This textbook covers the content of all eight ASE areas plus all of the background and fundamental information needed by technicians.

REVIEW QUESTIONS

1. In 1900, what was the most produced vehicle powered by?
2. What parts are included in the vehicle chassis?
3. Why were early engines called flat heads?
4. What is the difference between a unit-body and body-on-frame vehicle?
5. The powertrain consists of what components?

CHAPTER QUIZ

1. The first self-propelled vehicle that used an OTTO cycle four-stroke gasoline engine was produced in _____.
   a. 1885 **c.** 1902
   b. 1900 **d.** 1908
2. Early vehicles were constructed mostly of what material?
   a. Steel
   b. Cast iron
   c. Wood
   d. Tin
3. Which component is *not* part of the chassis system?
   a. Frame
   b. Electrical system
   c. Suspension
   d. Brakes
4. Early engines were called flat head design because they _____.
   a. were only inline engines
   b. did not include valves
   c. used valves beside the cylinder
   d. used spark plugs at the top of the cylinders
5. A V-type engine could have how many cylinders?
   a. 4 **c.** 8
   b. 6 **d.** Any of the above
6. What component regulates the temperature of the coolant in an engine?
   a. Cooling (water) jackets
   b. Thermostat
   c. Cooling fan(s)
   d. Radiator

7. A malfunction indicator light (MIL) on the dash may be labeled _____.
   a. check engine
   b. service vehicle soon
   c. MIL
   d. MAL
8. To retrieve stored diagnostic trouble codes, a service technician needs a _____.
   a. paper clip
   b. desktop computer
   c. wireless connection to an electronic tester
   d. scan tool
9. A four-wheel drive vehicle often uses a _____ to transmit torque to all four wheels.
   a. drive shaft
   b. U-joint
   c. transaxle
   d. transfer case
10. Automotive service systems are generally separated into how many content areas?
   a. 4
   b. 6
   c. 8
   d. 10

chapter 2

CAREERS IN THE AUTOMOTIVE SERVICE INDUSTRY

LEARNING OBJECTIVES:

After studying this chapter, the reader should be able to:

Discuss the need for servicing vehicles and the sites at which servicing is performed.

Describe the various technician positions and the training experience needed for each.

Explain the relationship of the service advisor and the service manager to others in a shop.

Discuss parts-related jobs and sales jobs in the automotive service industry and explain the typical automotive organization arrangement.

KEY TERMS: Entrepreneur 14 • On-the-job training (OJT) 11 • Parts counter person 14 • Service advisor 13 • Service consultant 13 • Service manager 13 • Service writer 13 • Shop foreman 13 • Team leader 13 • Technician (tech) 9 • VIN 12 • Work order 12

THE NEED FOR AUTOMOTIVE TECHNICIANS

The need for trained and skilled automotive **technicians** is greater than ever for several reasons, including:

- Vehicles are becoming more complex and require a higher level of knowledge and skills.
- Electrical and electronic components and sensors are included throughout the vehicle.
- Construction of parts and materials being used has changed over the last few years, requiring that all service work must be done to specified procedures to help avoiding damage to the vehicle.
- Increasing numbers of different types of lubricants and coolants make even routine service challenging.

All of the above issues require proper training and the ability to follow factory specified procedures to ensure customer satisfaction. The number of service technicians needed is increasing due to more vehicles on the road. A good service technician can find work in almost any city or town in the country, making the career as a professional service technician an excellent choice.

THE NEED FOR CONTINUOUS VEHICLE SERVICE

Vehicles are lasting longer due to improved materials and more exacting tolerances. Every year, vehicles are being driven farther than ever before. It used to be (in the 1950s) that the life of a vehicle was considered to be 100,000 miles or 10 years. Now achieving 200,000 miles without a major repair is common with proper maintenance and routine service. However, even the amount of needed routine service has been reduced due to changes in the vehicles, such as radial tires that now last 40,000 miles instead of older tires that were worn out and needed to be replaced every 15,000 miles.

WARRANTIES A warranty is a guarantee to the purchaser of a vehicle that it will function as specified. The warranty covers the quality and performance of the product and states the conditions under which the warranty will be honored. Vehicle warranties vary, but all warranties indicate a time and mileage restriction. The expressed warranties often include the following areas:

- New vehicle limited warranty that covers most components and is commonly called a bumper-to-bumper policy.
- Powertrain warranty covers the engine, transmission/transaxle, and final drive units. This coverage usually is longer than the bumper-to-bumper coverage.
- Sheet metal rust through warranty is usually longer than the bumper-to-bumper and powertrain warranty and covers rust if a hole occurs starting from inside the outer metal surface of the body.
- Emission control device warranties depend on the emission rating, the warranty coverage of the powertrain control module (PCM), and the catalytic converter and are covered for 8 years and 80,000 miles up to 10 years and 150,000 miles.

Vehicle warranties, unless an emergency repair, must be performed at a dealership, which is certified by the vehicle manufacturer to perform the repairs. At the dealership, the technician performing the repair must also be certified by the vehicle manufacturer.

All technicians should be familiar with what may be covered by the factory warranties to help ensure that the customer does not have to pay for a repair that may be covered. While warranties do cover many components of the vehicle, wear and service items are not covered by a warranty in most cases and, therefore, offer excellent opportunity for additional service work for trained automotive technicians.

INCREASING AGE OF A VEHICLE The average age of a vehicle on the road today has increased to older than nine years. This trend means that more vehicles than ever are not covered by a factory warranty and are often in need of repair. Aftermarket warranties also can be used at most repair facilities, making it very convenient for vehicle owners.

TECHNICIAN WORK SITES

Service technician work takes place in a variety of work sites including:

NEW VEHICLE DEALERSHIPS Most dealerships handle one or more brands of vehicle, and the technician employed at dealerships usually has to meet minimum training standards. The training is usually provided at no cost online or at regional training centers. The dealer usually pays the service technician for the day(s) spent in training as well as provides or pays for transportation, meals, and lodging. Most dealerships offer in-house on-line training with minimum off-site training. ● **SEE FIGURE 2–1.**

INDEPENDENT SERVICE FACILITIES These small- to medium-size repair facilities usually work on a variety of vehicles. Technicians employed at independent service facilities usually have to depend on aftermarket manufacturers' seminars or the local vocational school or college to keep technically up-to-date. ● **SEE FIGURE 2–2.**

FIGURE 2–1 Most large dealerships are busy in the morning with customers dropping off their vehicle and in the evening when they are being picked up.

FIGURE 2–2 A typical independent service facility. Independent garages often work on a variety of vehicles and perform many different types of vehicle repairs and service. Some independent garages specialize in just one or two areas of service work or in just one or two makes of vehicles.

FIGURE 2–3 This NAPA parts store also performs service work from the garage area on the side of the building.

MASS MERCHANDISER Large national chains of vehicle repair facilities are common in most medium- and large-size cities. Some examples of these chains include Sears, Goodyear, Firestone, and NAPA, as shown in ● **FIGURE 2–3.** Technicians employed by these chains usually work on a wide variety of vehicles. Many of the companies have their own local or regional training sites designed to train beginning service technicians and to provide update training for existing technicians.

SPECIALTY SERVICE FACILITIES Specialty service facilities usually limit their service work to selected systems or components of the vehicle and/or to a particular brand of vehicle. Examples of specialty service facilities include Midas, Speedy, and AAMCO Transmissions. Many of the franchised specialty facilities have their own technician training for both beginning and advanced technicians. ● **SEE FIGURE 2–4.**

FLEET FACILITIES Many city, county, and state governments have their own vehicle service facilities for the maintenance and repair of their vehicles. Service technicians are usually employees of the city, county, or state and are usually paid by the hour rather than on a commission basis. ● **SEE FIGURE 2–5.**

FIGURE 2–4 Midas is considered to be a specialty service shop.

FIGURE 2–5 A school bus garage is a typical fleet operation shop that needs skilled service technicians.

TECHNICIAN JOB CLASSIFICATIONS

There are many positions and jobs in the vehicle service industry. In smaller service facilities (shops), the duties of many positions may be combined in one job. A large city dealership may have all of the following vehicle service positions. A technician is often referred to as a **tech.**

LUBE TECH/QUICK SERVICE TECHNICIAN A lubrication technician should be trained in the proper use of hand tools and instructed how to properly service various types of vehicles. The training could be **on-the-job (OTJ)** or could be the result of high school or college automotive training. Some larger companies provide in-house training for new technicians and as a result they are trained to perform according to a specified standard. It is important that the lubrication technician double-check the work to be certain that the correct viscosity oil has been installed and to the specified level. The oil plug and oil filter must also be checked for leakage.

Lubrication technicians are trained to perform routine services including:

- Oil and oil filter change
- Chassis lubrication
- Fluids check and refill
- Tire inflation checks
- Accessory drive belt inspection
- Air filter check and replacement
- Cabin filter replacement
- Windshield wiper blade replacement

As a result of these tasks, the lubrication technician should be skilled in hoisting the vehicle and able to handle the tasks efficiently and in minimum time.

NEW VEHICLE PREPARATION FOR DELIVERY A new entry-level position at a dealership often includes preparing new vehicles for delivery to the customer. This is often referred to as "new car prep." The duties performed for new vehicle preparation are generally learned on the job. The vehicle manufacturer publishes guidelines that should be followed and it is the responsibility of the new vehicle preparation person to see that all items are checked and serviced, and all associated paperwork is completed. The activities normally associated with preparing a new vehicle for delivery include:

- Installing wheel center caps or wheel covers (if used)
- Installing roof racks, running boards, and other dealer- installed options
- Checking and correcting tire pressures

NOTE: Many vehicle manufacturers ship the vehicles to the dealer with the tires overinflated to help prevent movement of the vehicle during shipping.

- Checking all fluids
- Checking that everything works, including the remote key fob and all accessories
- Ordering any parts found to be broken, missing, and damaged in transit
- Removing all protective covering and plastic from the seats, carpet, and steering wheel
- Washing the vehicle

GENERAL SERVICE TECHNICIAN A general service technician usually has training as an automotive technician by one or more of the following methods:

- High school—Technical or vocational school or a comprehensive high school that has an Automotive Youth Education System (AYES) program or NATEF certification.
- College or technical school—Usually a two-year program that can earn the student an associate's degree.
- Career college or institute—Usually a 6-month to 12-month program earning the graduate a certificate.

Automotive service technicians perform preventative maintenance, diagnose faults, and repair automotive vehicles and light trucks.

Automotive service technicians adjust, test, and repair engines, steering systems, braking systems, drivetrains, vehicle suspensions, electrical systems, air-conditioning systems, and perform wheel alignments. In large shops, some technicians specialize in repairing, rebuilding, and servicing specific parts, such as braking systems, suspension, and steering systems. In smaller shops, automotive service technicians may work on a wider variety of repair jobs.

Automotive service technicians begin by reading the work order and examining the vehicle. To locate the cause of faulty operation and repair it, a technician will:

- Verify the customer concern
- Use testing equipment, take the vehicle for a test-drive, and/or refer to manufacturer's specifications and manuals
- Dismantle faulty assemblies, repair, or replace worn or damaged parts
- Reassemble, adjust, and test the repaired mechanism
- Automotive service technicians also may:
- Perform scheduled maintenance services, such as oil changes, lubrications, and filter replacement
- Advise customers on work performed, general vehicle conditions, and future repair requirements

WORKING CONDITIONS Most automotive service technicians work a 40-hour, five-day week. Some evening, weekend, or holiday work may be required. The work is sometimes noisy and dirty. There is some risk of injury involved in working with power tools and near exhaust gases.

SKILLS AND ABILITIES The work is most rewarding for those who enjoy doing precise work that is varied and challenging. Also, technicians usually achieve job security and a feeling of independence.

To be successful in the trade, automotive service technicians need:

- Good hearing, eyesight, and manual dexterity (ability to work with their hands)
- Mechanical aptitude and interest
- The ability to lift between 25 and 50 pounds (11 and 25 kilograms)
- The willingness to keep up-to-date with changing technology

A working knowledge of electricity, electronics, and computers is also required for many service procedures.

EMPLOYMENT AND ADVANCEMENT. Automotive service technicians are employed by automotive repair shops, specialty repair shops, service facilities, car and truck dealerships, and by large organizations that own fleets of vehicles.

? FREQUENTLY ASKED QUESTION

Why Is the Work Order Important?

The **work order** is a legal document that includes the description of the vehicle and the work requested by the customer. The customer signs the work order authorizing that the stated work be performed. If there are additional faults found, the shop must notify the customer and get permission to change the amount or extent of the work originally authorized. As work is performed on the vehicle, the parts used and the labor operation performed are added. This creates a complete file on the repair. This means that the vehicle has to be properly identified by including the **vehicle identification number (VIN)** on the work order. There is only one vehicle with that VIN, yet there may be many "white Chevrolet pickup trucks."

The work order is the paper trail that shows all operations, labor times, and parts used when the vehicle is in control of the shop. A work order is often required even when the technician is working on his or her own vehicle.

Experienced automotive service technicians may advance to service manager or shop foreman; some automotive service technicians open their own repair facilities.

Many technicians can also start work in a shop or dealership and learn on the job. Most technicians keep up-to-date by attending update seminars or training classes on specific topics throughout the year.

Specific tasks performed by a general service technician can include the following:

- All of the tasks performed by the lubrication technician
- Engine repairs, including intake manifold gasket replacement; cylinder head replacement; and oil and water pump replacement plus other engine-related tasks
- Brake system service and repair, including disc brakes, drum brakes, parking brake, and antilock brake (ABS) diagnosis and service
- Suspension-related service, including tire inspection and replacement, shock and strut replacement, servicing or replacing wheel bearings, performing steering component inspection and parts replacement, and performing wheel alignment and vibration diagnosis
- Electrical-related diagnosis and repair, including starting and charging problems, correcting lighting and accessory faults, and general service, such as light bulb replacement and key fob reprogramming
- Heating, ventilation, and air conditioning work, involving the use of diagnostic and service equipment that requires special training and certification if working with refrigerants
- Engine performance-related diagnosis and repair, including replacing fuel pumps and filters, cleaning or replacing fuel injectors, service ignition system components, solving emissions-related failures; and determining the cause and correcting "Check Engine" lights
- Manual transmission service and repairs, including replacing clutches, adjusting, or replacing clutch linkage; and performing four-wheel-drive diagnosis and service procedures
- Automatic transmission service and repairs, including performing routine automatic transmission service, removing

and replacing automatic transmissions, servicing differentials, transmissions/transaxles and performing diagnosis and service checks including fluid pressure and scan tool diagnosis

The vehicle is then driven by the service technician to verify the repair.

TECHNICIAN TEAM LEADER A **team leader** is an experienced service technician who is capable of performing most, if not all, of the work that the shop normally handles. The team leader assigns work to others in the group based on the experience or competency of the technician. The team leader then checks the work after it has been completed to be sure that it has been correctly performed. The number of hours of labor for each member of the team is totaled each pay period. Each member of the team is paid an equal share of the time, but at different rates. The team leader gets a higher per hour rate than the others on the team. The rate of pay per hour is based on the level of training and experience. A beginning technician may or may not be paid as part of the total team hours depending on how the team system is organized. While some shops do not use teams, many large shops or dealerships have two or more teams. The advantage of a team-type organization is that everyone on the team looks out and helps each other if needed because they are all paid based on the number of hours the team generates. The team leader performs the duties of a shop foreman, but only for those members on the team and not the entire shop. The team leader is under the direction and control of the service manager.

SERVICE MANAGEMENT JOB CLASSIFICATIONS

SHOP FOREMAN A **shop foreman** (usually employed in larger dealerships and vehicle repair facilities) is an experienced service technician who is usually paid a salary (so much a week, month, or year). A shop foreman is a knowledgeable and experienced service technician who keeps up-to-date with the latest vehicle systems, tools, and equipment. Typical shop foreman's duties include:

- Test-driving the customer's vehicle to verify the customer concern (complaint)
- Assigning work to the service technicians
- Assisting the service technicians
- Helping to maintain the shop and shop equipment
- Assisting the service manager
- Verifying that the repair is completed satisfactorily

The shop foreman is under the direction and control of the service manager.

SERVICE ADVISOR A **service advisor**, also called a **service writer** or **service consultant**, is the person at the dealership or shop designated to communicate the needs of the customer and accurately complete a work order.

A service advisor should:

- Have a professional appearance
- Be able to speak clearly
- Be able to listen carefully to the customer
- Write neatly and/or type accurately
- Be familiar with industry and shop standards and procedures

Most service advisors would benefit from taking a short course on service advising skill development and interpersonal relationship building. A service advisor should be familiar with the operation of the vehicle, but not to the same level as a service technician. A service advisor should not diagnose the problem, but rather state clearly on the work order what, when, and where the problem occurs so that the service technician has all the needed information to make an accurate diagnosis.

The service advisor's duties include:

1. Recording the vehicle identification number (VIN) of the vehicle on the work order
2. Recording the make, model, year, and mileage on the work order
3. Carefully recording what the customer's complaint (concern) is so that the service technician can verify the complaint and make the proper repair
4. Reviewing the customer's vehicle history file and identifying additional required service
5. Keeping the customer informed as to the progress of the service work

A service advisor must be at the shop early in the morning to greet the customers and often needs to stay after the shop closes to be available when the customer returns at the end of the day.

SERVICE MANAGER The **service manager** rarely works on a vehicle, but instead organizes the service facility and keeps it operating smoothly. A service manager can be a former service technician or, in many larger dealerships, a business major graduate who is skilled at organization and record keeping. The service manager handles all of the paperwork associated with operating a service department.

NOTE: In a small shop, the shop owner usually performs all of the duties of a shop foreman and service manager, as well as the lead technician in many cases.

Typical duties of a service manager include:

- Establishing guidelines to determine the technicians' efficiency
- Supervising any warranty claims submitted to the vehicle manufacturer or independent insurer
- Evaluating and budgeting for shop tools and equipment
- Establishing service department hours of operation and employee schedules
- Assigning working hours and pay for technicians and others in the service department
- Establishing procedures and policies to keep the service area clean and properly maintained

TECH TIP

Check the Vehicle before Work Is Started

As part of the work order writing process, the service advisor should look over the vehicle and make a written note of any body damage that may already exist. If any damage is noted, it should be mentioned to the customer and noted on the work order. Often the customer is not aware of any damage, especially on the passenger side, and thus would blame the shop for the damage after the service work was performed.

PARTS-RELATED POSITIONS

The parts manager and other parts personnel, such as the **parts counter person**, are responsible for getting the correct part for the service technician.

PARTS COUNTER PERSON A parts counter person often learns job skills by on-the-job training. A good parts counter person must be able to greet and easily talk to customers and technicians. A parts counter person must also have computer skills and the willingness to help others.

The parts counter person usually has the following duties:

- Greet the customer or technician
- Locate the correct parts for the service technician or customer
- Suggest related parts (retail customers)
- Stock shelves
- Check in delivered parts
- Take inventory
- Keep the parts department clean
- Help the parts manager

SEE FIGURE 2–6.

PARTS MANAGER The specific duties of a parts manager usually include:

- Ordering parts from the vehicle manufacturers and aftermarket companies
- Stocking parts
- Organizing the parts department in a clear and orderly fashion
- Locating parts quickly within the parts department
- Developing contacts with parts departments in other local dealerships so that parts that are not in stock can be purchased quickly and at a reasonable cost

FIGURE 2–6 Parts counter people need to know many aspects of automotive repair to be effective with customers.

VEHICLE SALES JOBS

SALESPERSON When a vehicle is sold, it generates a potential customer for the service department. New and many used vehicle sales dealerships employ salespeople to help the customer select and purchase a vehicle. The salesperson should have excellent interpersonal skills, as well as be familiar with the local and regional laws and taxes to be able to complete all of the paperwork associated with the sale of a vehicle. The usual duties of a vehicle salesperson include:

- Greet the customer
- Introduce yourself and welcome the customer to the store
- Qualify the customer as to the ability to purchase a vehicle
- Demonstrate and ride with the customer on a test-drive
- Be able to find the answer to any question the customer may ask about the vehicle and/or financing
- Be able to complete the necessary paperwork
- Follow up the sale with a telephone call or card

SALES MANAGER A sales manager is an experienced salesperson who is able to organize and manage several individual salespeople. The duties of a sales manager include:

- Establish a schedule where salespeople will be available during all hours of operation
- Consult with salespeople as needed on individual sales
- Train new salespeople
- Conduct sales promotion activities
- Attend or assign someone to attend vehicle auctions to sell and/or purchase vehicles
- Keep up-to-date with the automotive market
- Purchase vehicles that sell well in the local market
- Answer to the general manager or dealership principal

? FREQUENTLY ASKED QUESTION

What Is an Entrepreneur?

An **entrepreneur** is a person who starts and operates a business. Many service technicians want to eventually own their own shop and become an entrepreneur. However, operating a shop involves many duties and responsibilities that many service technicians lack, including:

- Bookkeeping and accounting skills
- Tax preparation (local, state, and federal)
- Sales tax collection and payment
- Health insurance arrangements for employees
- Unemployment compensation payments
- Workers' compensation payments
- Uniform payment
- Real estate taxes
- Garage keepers liability insurance

While at first it may seem like owning your own shop would be great, a good technician can often make more money, and have fewer headaches, by simply working for someone else.

OTHER CAREERS IN THE AUTOMOTIVE INDUSTRY

Other careers in the automotive industry include:

- Sales representative for automotive tools and equipment
- Technical trainers
- Technical school instructors
- Wholesale parts warehouse management
- Insurance adjuster
- Automotive technical writer
- Warranty claim examiner

TYPICAL AUTOMOTIVE ORGANIZATION ARRANGEMENT

LARGE COMPREHENSIVE NEW VEHICLE DEALER A typical dealership includes many levels because there are many departments such as sales (new and used) as well as the service, parts and body shops to manage. ● **SEE FIGURE 2-7.**

INDEPENDENT SHOP. An independent shop may or may not have a shop foreman, depending on the number of technicians and the volume of work. Larger independent shops have a shop foreman, whereas at smaller shops, the owner is the shop foreman. ● **SEE FIGURE 2-8.**

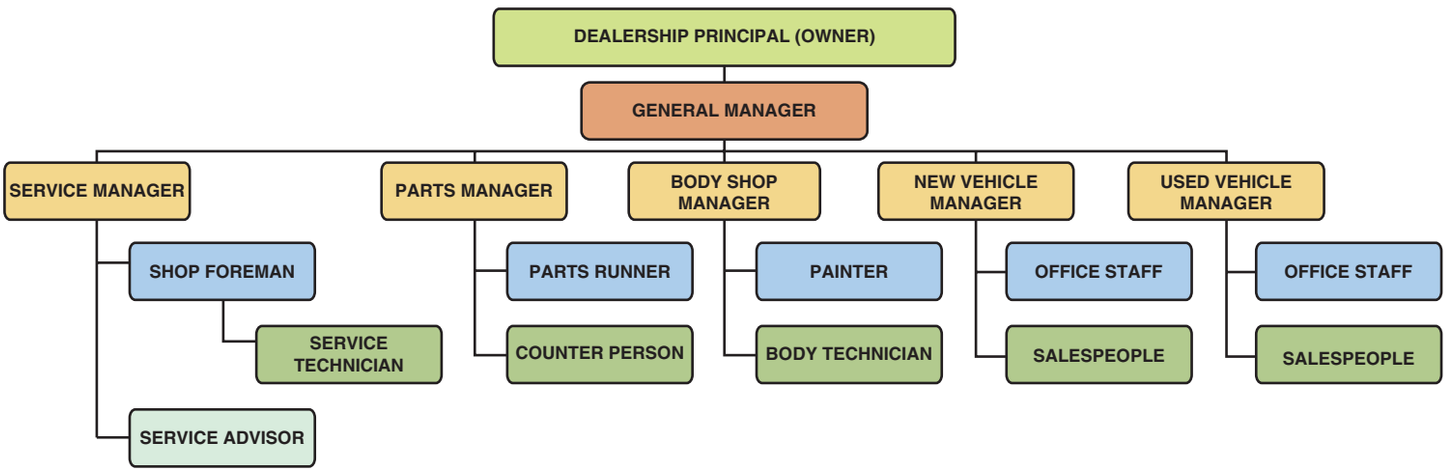


FIGURE 2-7 A typical large new vehicle dealership organizational chart.

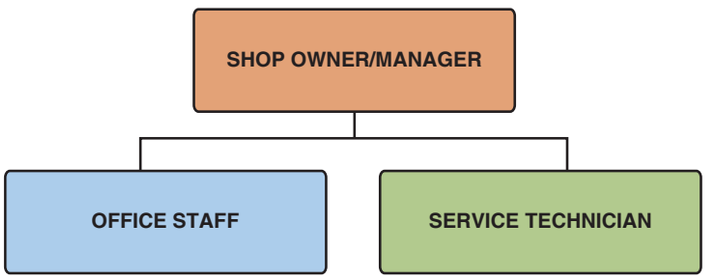


FIGURE 2-8 A typical independent shop organizational chart.

REVIEW QUESTIONS

1. What should be included on a work order?
2. What are some examples of mass merchandiser facilities?
3. What tasks are usually performed by a general service technician?
4. What duties are performed by the shop foreman and service manager?
5. What duties are performed by a parts counter person?

CHAPTER QUIZ

1. A vehicle needs a repair while still under warranty. Who is most likely to perform the repair?
   a. Any technician at the vehicle dealership
   b. A trained technician at any repair shop
   c. Any ASE-certified technician
   d. A certified technician at the vehicle dealership
2. A service advisor is called a _____.
   a. shop foreman
   b. service manager
   c. service writer
   d. service technician
3. All of the following are usual duties of a lube technician *except* _____.
   a. oil change
   b. air filter replacement
   c. water pump replacement
   d. accessory drive belt inspection
4. New vehicle preparation is usually an entry-level vehicle service position and usually involves what duties?
   a. Installing dealer-installed options
   b. Correcting tire pressures
   c. Removal of all protective coverings and plastic
   d. Any of the above
5. What is *not* a duty of a general service technician?
   a. Have the customer sign the work order
   b. Order the parts needed
   c. Diagnose the customer's concern
   d. Perform vehicle repair procedures
6. Two technicians are discussing the duties of a shop foreman and a service manager. Technician A says that a shop foreman diagnoses vehicle problems. Technician B says that the service manager usually repairs vehicles. Which technician is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technicians A and B
   d. Neither Technician A nor B
7. Who greets the service customer and completes the work order?
   a. Service manager
   b. Service advisor
   c. Service writer
   d. Either b or c
8. Which job would be concerned with the maintenance of the shop equipment?
   a. Service manager
   b. Shop foreman
   c. Shop owner
   d. Any of the above
9. Which job would be concerned with assigning working hours and pay?
   a. Service manager
   b. Shop foreman
   c. Service advisor
   d. Service technician
10. Who is responsible for finding the correct part needed by the service technician?
    a. Counter person
    b. Service technician
    c. Shop foreman
    d. Service advisor

chapter 3

STARTING A CAREER IN THE AUTOMOTIVE INDUSTRY

LEARNING OBJECTIVES:

After studying this chapter, the reader should be able to:

Explain the options and preparations for applying for a job.
Describe what the resume and cover letter should include.
Discuss the process of applying for employment, interviewing, and accepting employment.
Explain how the flat-rate pay plan works.
Discuss the payroll deductions and the expenses of an employee working in the automotive industry.

KEY TERMS: Apprentice program 18 • Clock-in 22 • Clock time 22 • Commission pay 22 • Cooperative education 18 • Federal tax 22 • FICA 22 • Flat-rate 22 • Gross 22 • Housing expense 23 • Incentive pay 22 • Job shadowing 17 • Net 22 • Part-time employment 18 • Reference 20 • Resume 19 • Soft skills 18 • State tax 22 • Straight time 22

PREPARING FOR AN AUTOMOTIVE SERVICE CAREER

DESIRE AND INTEREST If a person has an interest in automobiles and trucks and likes computers, the automotive service field may be a good career choice. Computer skills are needed in addition to hands-on skills for several reasons, including:

- Service information, such as diagnostic procedures and specifications, is commonly available in electronic format.
- Work orders are commonly written and sent to the technician electronically. The technician needs typing skills to type the steps taken during the service or repair procedures.
- Warranty claims are often submitted by the Internet and computer skills are needed to quickly and accurately submit claims and answer questions from the insurance company.

Interest in vehicles is also very important toward being successful as a professional service technician. Most technicians enjoy working on vehicles, not only professionally, but also during their spare time. Many technicians own a project vehicle, which could include:

- Drag race vehicle
- Race vehicle used in road racing
- A fun vehicle used on sunny weekend days and evenings
- Motorcycle
- Snowmobile or jet ski
- Truck for rock crawling

TECHNICAL KNOWLEDGE AND SKILLS The enjoyment of being involved with vehicles is very important because the job of servicing and repairing automobiles and trucks can be hard and dirty work. Many men and women enjoy being around and learning about the details of vehicle operation. With these desires and interest, working in the automotive service field is a great career. Technical information, skills, and tools needed include:

TECH TIP

If in Doubt, Ask

No one expects a beginning service technician to know everything, but other technicians do not know what you do or do not know. It is usually assumed that the beginning technician will ask for help if they think they need the help. However, asking for help is very rare and requires the beginning technician to admit that they do not know something. Not asking for help can cause harm to the vehicle or the service technician. If in doubt—always ask. No one will be upset and learning the answer to your question will help in the learning experience.

- **Hand tools and tool usage.** Owning and experience using hand tools is important for a service technician. All service technicians are expected to be able to remove and replace parts and components as needed in a timely manner using proper tools and techniques.
- **Technical knowledge.** While knowing how all aspects of the vehicle works is not expected of a beginning service technician, it is important that the technician have a basic understanding of the parts and procedures needed, at least, for routine service procedures.

JOB SHADOWING A great way to see what it is really like to work as a service technician is to follow a professional around for a day or more. **Job shadowing** is usually arranged through an

automotive program, and the shop or dealership has agreed to allow someone into the shop area to observe.

While it does allow the student to observe, job shadowing does not allow the person to perform any work or help the technician in any way. During the day, the person who is job shadowing has to wear all personal protective equipment as required by the technician and must observe all safety regulations. The advantages of job shadowing include:

- Being able to observe a typical day in the life of an automotive technician
- Being able to talk to the working technician about what is being done and why
- Being able to observe other technicians and seeing the various skill levels that often exist in a shop

COOPERATIVE EDUCATION PROGRAMS **Cooperative education** programs are formal programs of study at a high school or college where the student attends classes at the school, and also works at a local shop or dealership.

If a cooperative education program is held at the high school level, the work at the shop or dealership occurs during the afternoon or evening and during the summer between the junior and senior year. The most common high school cooperative program is called AYES, which means Automotive Youth Education System (see www.ayes.org). The vehicle manufacturers involved in this program include:

- General Motors
- Chrysler
- Toyota
- Honda
- Nissan
- BMW
- Kia
- Subaru
- Hyundai

If the cooperative education program is held at a community college, the work at the dealership occurs around the training sessions, usually the first or second half of a semester or on alternative semesters. The most common college programs include:

- General Motors ASEP (Automotive Service Educational Program) (see *www.gmasepbsep.com*)
- Ford ASSET (Automotive Student Service Educational Program) (see *www.fordasset.com*)
- Chrysler CAP (College Automotive Program) (see *www.chryslercap.com*)
- Toyota T-TEN (Toyota Technician Education Network) (see *www.toyota.com/about/tten/index.html*)

Another factory sponsored program open to those who have already completed a postsecondary automotive program is BMW STEP (Service Technician Education Program) (see *www.bmwusa.com/about/techtraining.html*).

APPRENTICE PROGRAMS An **apprentice program** involves a beginning service technician working at a shop or dealership during the day and attending training classes in the evening. The key advantage to this type of program is that money is being earned due to full-time employment and getting on-the-job training (OJT) during the day. Often the shop or dealership will help pay for training. While this program usually takes more than two years to complete, the work performed at the shop or dealership usually becomes more technical as the apprentice becomes more knowledgeable and gets more experienced.

PART-TIME EMPLOYMENT Working part time in the automotive service industry is an excellent way to get hands-on experience, which makes it easier to relate classroom knowledge to everyday problems and service issues. Working part time gives the student technician some flexibility as to college schedules and provides an income needed for expenses. Often **part-time employment** becomes full-time employment so it is important to keep attending technical classes toward becoming an asset to the company.

DEVELOPING AN EMPLOYMENT PLAN

An employment plan is an evaluation of your skills, interest, and talents. Selecting a career is different than getting a job. A typical job, while it does involve some training, usually can be learned in a few days to several months. However, a career requires many years to achieve competence. Therefore, selecting a career should require a thorough self-examination to determine what your true interest is in a particular career field. Some items that you should enjoy or would be willing and able to learn include:

- Working with your hands, using tools and equipment
- Computer usage, including typing skills
- Working in an area where lifting is often required
- Being able to read, understand, and follow service information, technical service bulletins, and work orders
- Being able to perform diagnostic work and figure out the root cause of a problem

SOFT SKILLS In addition, any career, including being a service technician, requires many people skills, often called **soft skills**. These people-related skills include:

- Working cooperatively with other people
- Communicating effectively with others verbally (speech) and in writing
- Working as a member of a team for the benefit of all
- Being able to work by yourself to achieve a goal or complete a job assignment
- Being able to lead or supervise others
- Willingness to work with others with a different background or country of origin
- Being a good citizen (citizenship) within the community by participating in local and regional activities and showing leadership within your profession

LOCATING EMPLOYMENT POSSIBILITIES Locating where you wish to work is a very important part of your career. Of course, where you would like to work may not have an opening and you may have to work hard to locate a suitable employer. First, try to select a shop or dealership where you think you would like to work because of location, vehicles serviced, or other factors. Ask other technicians who have worked or are presently working there to be sure that the location would meet your needs.

If looking for employment through a want ad in a newspaper or employment Web site, check the following:

- **Job description.** Is this a position that could advance into a more technical position?
- **Tools needed.** Most professional service technician positions require that the technician provide their own tools. (The shop or dealership provides the shop equipment.) Do you have the tools needed to do the job?
- **Hours needed.** Are you available during the hours specified in the ad?
- **Drug testing.** Is a drug test needed for employment and are you prepared to pass?

PREPARING A RESUME

A **resume** is usually a one-page description of your skills, talents, and education. It is used by prospective employers to help narrow the field of applicants for a job or position. The number one purpose of a resume is to obtain a job interview. A good resume should include the following items:

Personal Information

- Full given name (avoid nicknames)
- Mailing address (do not use a post office [PO] box)
- Telephone and/or cell phone number
- E-mail address
- Avoid using dates that could indicate your age

Sample Resume

Personal Information:

James Hartman
301 Main Street
City, State 40005
Telephone: (555) 555-0170
Cell: (555) 555-1139

Career Goal:

To become a certified ASE master technician and work at a new vehicle dealership.

Experience:

2018 to present—I work part time (20 hours per week) at Miller Service performing routine vehicle service, including oil changes, tire balancing, brake repairs, timing belt replacement, and intake manifold gasket replacement. I have assisted with suspension and air-conditioning repairs and own a basic set of hand tools.

Education:

High school diploma from Central High School, City, State 40010. I am finishing a two-year automotive technician training program at City College, City, State 40010 (to be completed May 15).

Additional Training and Certification:

ASE certified in Brakes and Engine Repair.
Attended a seminar on wide-band oxygen sensors and electronic throttle control at a local automotive service exposition.

Other Skills and Interests:

I am restoring a 1969 Chevrolet Camaro, including all mechanical repairs and upgraded suspension system.

References:

Available upon request.

Educational Information

- Highest education level achieved
- Major, if in a college or in a training program

Experience and Skills

- Work or volunteer experience that may be helpful or useful to an employer. For example, if you took a course in welding, this may be useful to a shop owner who is looking for a service technician who could do welding, even though this fact was not included in the job posting.
- A valid driver's license is a must for most professional service technicians.
- A good driving record. Often the shop insurance company will not allow a shop owner to hire a technician with a poor driving record.

REFERENCES A **reference** is someone who is willing to tell a possible employer about you, including your skills and talents, as well as your truthfulness and work habits.

Most employers would like to see someone who is familiar with you and your family, such as a priest, minister, or elder in your church. Some teachers or coaches also can be asked to be a reference. Always ask the person for approval before including the person on your list of references. Ask the reference to supply you with a written recommendation. Some references prefer to simply fill out a reference questionnaire sent by many companies. If a reference sends you a written recommendation, have copies made so they can be included with your resume.

Sample Cover Letter

301 Main Street
City, State 40005
Telephone: (555) 555-0170
Cell: (555) 555-1139

Date

Mr. John Smith
Smith Dealership
800 North Street
City, State 40010

Dear Mr. Smith:

I am applying for the position of general service technician at your dealership as advertised in the Sunday, January 7, edition of the Daily News.

I am currently finishing my studies in Automotive Technology at City College and have worked part time at Miller Service for the past two years. I am ASE certified in Brakes and Engine Repair and plan to become certified in all eight areas. I have my own tools and currently can work in the afternoons and evenings. After May 15, I will be able to work full time after completing my automotive courses.

I look forward to the opportunity to discuss my skills and resume in an interview. Thank you for your consideration.

Sincerely,

James Hartman

Enclosure (1)

PREPARING A COVER LETTER

When answering an advertisement in a newspaper or magazine, be sure to include the details of where you saw the ad in your cover letter to the employer. For example: "I am applying for the position as an entry-level service technician, as published in the August 15, edition of the Daily News."

If the requirements for the position are listed, be sure to include that you do have the specified training and/or experience and the tools needed for the job.

If calling about a position, be sure to state that you are applying for the position posted and ask to speak to the correct person or to the person mentioned in the ad.

TECH TIP

Always Be Truthful

No one is smart enough to be a liar. If you say something that is not true, then you have to remember what was said forever or your lie will often be discovered. If asked about your experience or knowledge, try to be as truthful as possible. Facts and skills can be learned and not knowing how to do everything that a shop may be involved with is not an indication that you will be rejected from the job opening.

CONTACTING POTENTIAL EMPLOYERS

When a job opening is posted in a newspaper or it is mentioned by a friend, most experts recommend that you visit the shop or dealership in person to see where the job is located, the condition of the buildings, and the surrounding areas. This trip could also be used for you to submit your resume and cover letter in person unless the company indicates otherwise. Be prepared to be interviewed when submitting your resume. Even if the position has already been filled, the trip gives you experience in meeting people and seeing the shop, which helps increase your confidence during the job search. Searching for a job is a full-time job in itself. Be prepared every day to answer ads, search employment Web sites and travel to shops or dealerships.

COMPLETING THE EMPLOYMENT APPLICATION

Most businesses require that an employment application be completed because it not only asks for all necessary personal information needed, but also references and emergency contacts. Most employment application forms ask for previous employers, the names and telephone numbers of contact people, and other information which you may not remember. It is wise to have all of the information written down ahead of time and take it with you for reference when completing the application. Always answer questions honestly and as thoroughly as possible. Never lie on an employment application.

THE INTERVIEW

When meeting for the job interview, be sure to dress appropriately for the position. For example, a suit and tie would not be appropriate for an interview for a service technician position. However, the following may be a helpful guide:

- Wear shoes that are not sneakers and be sure they are clean
- Wear slacks, not jeans
- Wear a shirt with a collar
- Do not wear a hat
- Be clean shaven or have beard/mustache neatly trimmed
- Have clean hair
- Avoid facial jewelry
- Women-keep makeup and jewelry to a minimum

During the interview, try to answer every question honestly. Emphasize what you are capable of providing to the shop including:

- Enthusiasm
- Experience
- Willingness to work
- Willingness to work long hours and/or long weeks

AFTER THE INTERVIEW

After the interview, follow up with a letter thanking the shop for the interview. In the letter include when the interview occurred and that from the information you received, that you are very interested in becoming a part of the organization (shop or dealership). Also include contact information, such as your cell phone number and e-mail address, so the service manager can easily get in contact with you. A quick review of your skills and talent will also be helpful to the shop owner or service manager.

ACCEPTING EMPLOYMENT

When a job is offered, there will likely be some paperwork that needs to be filled out and decisions made. Some of the requested information could include:

- Social security number (social insurance number in Canada)
- W-4 tax withholding form
- Emergency contact people
- Retirement plan selection (This is usually given to you to study and return at a later date.)
- Other information which may be unique to the shop or dealership

After accepting the employment position, be sure to determine exactly what day and time you should report to work and try to determine where your tools should be placed. Most places will show you around and introduce you to others you will work with.

TECHNICIAN PAY METHODS

STRAIGHT-TIME PAY METHODS When the particular service or repair is not covered or mentioned in a flat-rate guide, it is common practice for the technician to **clock-in** and use the actual time spent on the repair as a basis for payment. The technician uses a flat-rate time ticket and a time clock to record the actual time. Being paid for the actual time spent is often called **straight time** or **clock time**. Difficult engine performance repairs are often calculated using the technician's straight time.

FLAT-RATE PAY METHODS Beginning service technicians are usually paid by the hour. The hourly rate can vary greatly depending on the experience of the technician and type of work being performed. Most experienced service technicians are paid by a method called **flat-rate**. The flat-rate method of pay is also called **incentive** or **commission pay**. "Flat-rate" means that the technician is paid a set amount of time (flat-rate) for every service operation. The amount of time allocated is published in a flat-rate manual. For example, if a bumper requires replacement, the flat-rate manual may call for 1.0 hour (time is always expressed in tenths of an hour). Each hour has 60 minutes. Each tenth of an hour is 1/10 of 60 or 6 minutes.

0.1 hour = 6 minutes
0.2 hour = 12 minutes
0.3 hour = 18 minutes
0.4 hour = 24 minutes
0.5 hour = 30 minutes
0.6 hour = 36 minutes
0.7 hour = 42 minutes
0.8 hour = 48 minutes
0.9 hour = 54 minutes
1.0 hour = 60 minutes

Many service operations are greater than 1 hour and are expressed as such:

2.4 hours = 2 hours and 24 minutes
3.6 hours = 3 hours and 36 minutes

The service technician would therefore get paid the flat-rate time regardless of how long it actually took to complete the job. Often, the technician can "beat flat-rate" by performing the operation in less time than the published time. It is therefore important that the technician not waste time and work efficiently to get paid the most for a day's work. The technician also has to be careful to perform the service procedure correctly because if the job needs to be done again due to an error, the technician does the repair at no pay. Therefore, the technician needs to be fast and careful at the same time.

The vehicle manufacturer determines the flat-rate for each labor operation by having a team of technicians perform the operation several times. The average of all of these times is often published as the allocated time. The flat-rate method was originally developed to determine a fair and equitable way to pay dealerships for covered warranty repairs. Because the labor rate differs throughout the country, a fixed dollar amount would not be fair compensation. However, if a time could be established for each operation, then the vehicle manufacturer could reimburse the dealership for the set number of hours multiplied by the labor rate approved for that dealership. For example, if the approved labor rate is $60.00 per hour and:

Technician A performed 6.2 hours × $60.00 = $372.00
Technician B performed 4.8 hours × $60.00 = $288.00
The total paid to the dealership by the manufacturer = $660.00

This does not mean that the service technician gets paid $60.00 per hour. Sorry, no! This means that the dealership gets reimbursed for labor at the $60.00 per hour rate. The service technician usually gets paid a lot less than half of the total labor charge.

Depending on the part of the country and the size of the dealership and community, the technician's flat-rate per hour income can vary from $7.00 to $20.00 or more per flat-rate hour. Remember, a high pay rate ($20 for example) does not necessarily mean that the service technician will be earning $800.00 per week (40 hours × $20.00 per hour = $800.00). If the dealership is not busy or it is a slow time of year, maybe the technician will only have the opportunity to "turn" 20 hours per week. So it is not really the pay rate that determines what a technician will earn, but rather a combination of all of the following:

- Pay rate
- Number of service repairs performed
- Skill and speed of the service technician
- Type of service work (A routine brake service may be completed faster and easier than a difficult engine performance problem.)

A service technician earns more at a busy dealership with a lower pay rate than at a smaller or less busy dealership with a higher pay rate.

PAYROLL DEDUCTIONS

GROSS VERSUS NET COMPENSATION Most beginning technicians start by receiving a certain amount of money per hours worked. **Gross** earnings are the total amount you earned during the pay period. The paycheck you receive will be for an amount called **net** earnings. Taxes and deductions that are taken from your paycheck may include all or most of the following:

- **Federal** income **tax**
- **State** income **tax** (not all states)
- Social Security taxes (labeled **FICA**, which stands for Federal Insurance Contribution Act)
- Health/dental/eye insurance deductions

In addition to the above, uniform costs, savings plan deductions, parts account deductions, as well as weekly payments for tools, may also reduce the amount of your net or "take-home" pay.

RETIREMENT INFORMATION AND PAYMENTS Some shops or dealerships offer some retirement savings plan, but the most commonly used is an employer-sponsored 401(k) account named after a section of the U.S. Internal Revenue Code. A 401(k) account allows a worker to save for retirement while deferring taxes on the saved money and earnings until withdrawal. Most 401(k) plans allow the employer to select from stock mutual funds or other investments. A 401(k) retirement plan offers two advantages compared to a simple savings account.

TECH TIP

Hourly Rate to Annual Income

To calculate the amount of income that will be earned using an hourly rate, do the following:

Multiply the hourly rate times 2 and then times 1,000.

For example: $10 per hour × 2 × 1,000 = $20,000 per year.

This easy-to-use formula assumes working eight hours an day, five days a week for 50 weeks (instead of 52 weeks in the year).

The reverse can also be easily calculated:

Divide the yearly income by 2 and then by 1,000 = hourly rate

For example: $36,000 per year ÷ 2 = $18,000 ÷ 1,000 = $18 per hour

- The contributions (money deposited into the account) are tax deferred. The amount will increase due to interest and no taxes are due until the money is withdrawn.
- Many employers provide matching contributions to your 401(k) account which can range from 0% (no matching contributions) to 100%.

The savings really add up over time. For example, if you start saving at age 25 and your income averages $3,000 per month ($36,000 per year) and you contribute 6% of your pay and the employer contributes 3%, after 40 years at age 65, the account will be worth $1,700,000 (one million, seven hundred thousand dollars) assuming a 10% average return.

In retirement, most experts agree that 4% of the total can be withdrawn each year and not reduce the capital investment. Four percent of $1,700,000 is $68,000 per year or over $5,600 per month every month for the rest of your life.

ADDITIONAL SERVICE TECHNICIAN BENEFITS Many larger dealerships and service facilities often offer some or all of the following:

- Paid uniforms/cleaning
- Vacation time
- Update training (especially new vehicle dealerships)
- Some sort of retirement (usually a contributing 401(k)) program
- Health and dental insurance (usually not fully paid)
- Discounts on parts and vehicles purchased at the dealership or shop

Not all service facilities offer all of these additional benefits.

HOUSING AND LIVING EXPENSES

As a general guideline, **housing expenses**, such as rent or a mortgage payment, should not exceed 30% of the gross monthly income. For example,

Ten dollars per hour times 40 hours per week = $400 per week times 4 weeks in a month = $1,600 per month. Thirty percent of $1,600 is $480 per month for rent or a mortgage payment.

FREQUENTLY ASKED QUESTION

Where Does All the Money Go?

Money earned does seem to quickly disappear. For example, if a soft drink and a bag of chips were purchased every day at work for $2.50, this amounts to $12.50 per week or $50 per month, which is $600 per year. Use the following chart to see where the money goes.

Income

Labor rate per hour× number of hours worked = ____

Overtime pay, if applicable = ____

Part-time work on weekends = ____

TOTAL WEEKLY INCOME = ____

Multiply by 4.3 to get the **MONTHLY INCOME** = ____

Monthly Expenses

Car/truck payment = ____

Rent/mortgage = ____

Gasoline = ____

Food (groceries) = ____

Fast food or restaurants = ____

Heat and electric (heat/air conditioning) = ____

Water and sewer = ____

Telephone (cell) = ____

Cable TV/Internet access = ____

Clothing (including cleaning) = ____

Credit card payment = ____

TOTAL MONTHLY EXPENSES = ____

Hopefully, the total income is more than the total expenses!

FREQUENTLY ASKED QUESTION

Employee or Contract Labor?

Most shops and dealerships hire service technicians as employees. However, some shops or businesses will pay a technician for services performed on a contract basis. This means that they are not hiring you as an employee, but simply paying for a service similar to having a plumber repair a toilet. The plumber is performing a service and is paid for the job rather than as an employee of the shop. An employer/employee relationship exists if the shop meets two factors:

1. **Direction**—This means that the employer can direct the technician to report to work to perform service work.
2. **Control**—This means that the employer can direct the hours and days when the work is to be performed and at the employer's location.

A contract labor association exists if the repairs are performed without both direction and control of the shop.

If a contract labor basis is established, then no taxes are withheld. It is then the responsibility of the technician to make the necessary and required general tax payments and pay all taxes on time.

A vehicle payment should not exceed 25% of the gross earnings. In the example where the pay was $10 per hour, the maximum recommended vehicle payment should be $400 per month.

BECOMING A SHOP OWNER

Many service technicians want to start and operate their own shop. Becoming a shop owner results in handling many non-automotive-related duties that some technicians do not feel qualified to handle, including:

- Handling customers
- Ordering and paying for shop equipment and supplies
- Bookkeeping, including payroll
- Budgeting for and paying for garage owner's insurance and workers' compensation
- Paying rent, as well as heat/air-conditioning bills
- Advertising expenses
- Hiring and firing employees

TECH TIP

Find Three Key People

An entrepreneur is a person who organizes and manages their own business assuming the risk for the sake of a profit. Many service technicians have the desire to own their own repair facility. The wise business owner (entrepreneur) seeks the advice of the following people when starting and operating their own business.

1. **Attorney (lawyer)**—This professional will help guide you to make sure that your employees and your customers are protected by the laws of your community, state, and federal regulations.
2. **Accountant**—This professional will help you with the journals and records that must be kept by all businesses and to help with elements, such as payroll taxes, unemployment taxes, and workmen's compensation that all businesses have to pay.
3. **Insurance Agent**—This professional will help you select the coverage needed to protect you and your business from major losses.

REVIEW QUESTIONS

1. What facts should be included on the resume?
2. What are five interviewing tips?
3. What is the difference between gross pay and net pay?
4. What taxes are usually withheld from a paycheck?
5. What are five duties of a shop owner?

CHAPTER QUIZ

1. A resume should be how many pages long?
   a. 1 **c.** 3
   b. 2 **d.** 4 or more
2. What personal information should *not* be included on the resume?
   a. Address
   b. Cell or telephone number
   c. Age
   d. Work experience
3. Why is having a good driving record good for the shop?
   a. Allows the use of a company vehicle
   b. Lowers insurance costs
   c. Allows you to drive customer's vehicles
   d. Permits you to use your vehicle to get parts
4. Which is *not* recommended during an interview?
   a. Wear shoes that are not sneakers
   b. Wear a shirt with a collar
   c. Have clean hair
   d. Wear jeans
5. During an interview, try to ____.
   a. show enthusiasm
   b. explain your work experience
   c. state your willingness to work
   d. All of the above
6. Flat rate time is expressed in tenths of an hour. Each tenth of an hour is _____ minutes.
   a. 60 **c.** 30
   b. 16 **d.** 6
7. One of the deductions from a paycheck is for Social Security. This item is usually shown on the pay stub as _____.
   a. Social Security
   b. SSA
   c. FICA
   d. U.S. government deduction
8. Technician A says that the net pay amount is usually higher than the gross pay amount. Technician B says that the gross pay amount is usually higher than the net pay. Which technician is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technicians A and B
   d. Neither Technician A nor B
9. A beginning service technician earns $400 per week. How much should the technician spend on a vehicle payment?
   a. $400 per month
   b. $800 per month
   c. $500 per month
   d. $1,000 per month
10. Which activity does not allow a person to perform any work while at the shop?
    a. Cooperative education program
    b. Apprenticeship program
    c. Job shadowing
    d. Part-time employment

chapter 4

WORKING AS A PROFESSIONAL SERVICE TECHNICIAN

LEARNING OBJECTIVES:

After studying this chapter, the reader should be able to:

Discuss how to start a new job and be a good employee.
Describe a service technician's duties and use of work orders.
Describe the types and pricing of parts.
Describe the advantages of having a mentor.
List useful business skills for service technicians to develop.
List housekeeping duties service technicians typically perform.
Explain formal and informal evaluations.

KEY TERMS: Advisor 31 • Advocate 31 • Aftermarket parts 30 • Coach 31 • Core 30 • Core charge 30 • Counselor 31 • Critical thinking 32 • Customer pay (CP) 29 • Formal evaluation 33 • Informal evaluation 33 • Jobber 30 • Mentor 31 • Original equipment (OE) 30 • Rebuilt 31 • Remove and inspect (R & I) 30 • Remove and replace (R & R) 30 • Renewal parts 30 • Repair order (RO) 28 • Role model 31 • Service bay 28 • Stall 28 • Teacher 31 • Three Cs (concern, cause, correction) 28 • Trainee 31 • Warehouse distributor 30

PROFESSIONALISM

Professionalism and personal credibility are important and can determine success as a service technician or as a customer service provider. A true professional does the following on a regular basis.

1. **Practice consistency.** Be positive, professional, and warm at all times.
2. **Keep your word.** Follow through with the commitments that you make. People will not have faith in you if you break your promises.
3. **Develop technical expertise.** Become very knowledgeable about the vehicles being serviced. Attend regular update training classes to keep up with the latest technical information and equipment.
4. **Become a teammate with your coworkers.** Working successfully with others shows that you have common goals and can benefit from the specific skills of others.
5. **Be accountable.** Practice honesty all of the time, admit mistakes, and take responsibility for actions. Apologize if you are wrong.

ETHICS Ethics are a set of principles that govern the conduct of an individual or group. Sometimes ethical decisions are easy to recognize and are perceived as popular choices of behavior by the people around us. At other times, the spectrum of potential choices falls into gray areas in which the "right" or "wrong" course of action is difficult or nearly impossible to identify. When faced with an ethically challenging situation, ask yourself the following questions:

- Is it legal? (Is it against local, state, or federal laws?)
- Is it fair? (Is it harmful to me or to others?)
- How do I feel about it? (Is it against the teachings of my parents or my religion?)

TECH TIP

Clean Clothes Are a Must

Anyone who meets the public in any business must not only be dressed appropriately, but the clothing should be clean. Service advisors and others that greet the public should also be sure that their shoes are shined. Dull, dirty, or scuffed shoes or a messy appearance reflects an unprofessional look.

- Would the court of public opinion find my behavior incorrect? (Would it disappoint my family?)
- Am I fearful of what those I trust would say about my actions? (Would I be hurt or upset if someone did this to me?)

The above questions can be quite revealing when attempting to choose an ethical course of action.

COMMUNICATIONS

The five main methods of communication used in effective customer service interaction include listening, talking, nonverbal communications, reading, and writing.

LISTENING Active listening is the ability to hear and understand what the speaker is saying. To listen to your customers or other technicians is to show them that you care about and respect their questions and concerns. It is not easy to be a good listener; it takes practice and dedication to improve your listening techniques. Listening is a skill that must continuously be developed.

Several barriers to good listening exist. A listener may be distracted from what is being said, have a closed mind to the speaker

TECH TIP

Never Use Profanity

Regardless of the situation, a true professional never resorts to the use of profanity. If tensions are high and the discussion becomes heated, try to defuse the situation by turning the situation over to someone else.

and the message, won't stop talking, or is lazy and unwilling to make the commitment to be a good listener.

Listening requires the listener to stop talking and to hear what the speaker is saying. It has been said that humans were given two ears and one mouth because we are supposed to listen twice as much as we speak. The best way to keep your mind focused on the speaker and to avoid becoming distracted is to pay attention. We can think about 10 times faster than we can speak, so frequently we have processed what speakers have said and are waiting for them to catch up with us. By focusing on speakers and on what is being said we are less likely to miss the messages being delivered. Putting that into practice is not as easy as it sounds.

A good listener does the following:

- Focuses on the speaker and what is being said.
- Looks at the speaker and makes eye contact when possible.
- Listens with an open mind.
- Rephrases what was said to clarify that the intended message is understood.
- A good listener knows the joy of sharing and communicating with others. Work to become the best listener you can be.

TALKING Talking means speaking, using words and terminology that others can comprehend. Eye contact is always important when we are communicating with others. Eye contact is allowing our eyes to make visual contact with someone else's. In our culture, eye contact conveys sincerity and interest. Avoiding eye contact may suggest a lack of concern or lack of honesty. Customers may perceive that a customer service provider is not interested in what they are saying if they do not periodically make eye contact with the customer.

When dealing with people from other cultures, customer service providers should be aware of cultural differences. In many other cultures eye avoidance is a sign of respect. Be sensitive to others, but use eye contact whenever possible.

NONVERBAL COMMUNICATION The tone and inflection of the voice, facial expressions, posture, hand movements, and eye contact are all forms of nonverbal communications. These nonverbal indicators can contradict the message conveyed through another method of communication.

Nonverbal communication includes body posture, such as having the arms crossed. When a person crosses their arms, or looks at other things rather than paying attention to what you are discussing, these actions could indicate one of several things, including:

1. They are not interested in what you are saying.
2. They don't believe what you are saying.
3. They are not listening.

If this type of nonverbal communication is noticed, there are several things that could be done to overcome this barrier, including:

FIGURE 4–1 When answering the telephone, be sure to have paper and pen or pencil handy to record the customer information.

TECH TIP

Always Have Paper and a Pen When on the Telephone

When talking to a customer, whether in person or on the telephone, have paper and a pencil or pen to record the necessary information. In this case, the customer service representative at a dealer is using a preprinted form to record the service procedures to be performed on a customer's vehicle while talking on the phone.
SEE FIGURE 4–1.

1. Ask questions, which would require them to pay attention, plus it shows that you are interested in what they think.
2. Give the customer options rather than just ask them what they want, such as saying "would you prefer to have this work done all at the same time or spread out over several weeks?"

TELEPHONE COMMUNICATION A large percentage of customers make first contact with a shop or dealer service department by telephone. Service technicians normally do not talk to customers directly, but may be asked to help clarify a repair or a service procedure.

Some suggestions when talking on the telephone include:

- Use proper titles for the people with whom you communicate. If in doubt about whether to use a first name, call the person by the more formal *Mr.* or *Ms.* If they prefer the more informal first name, they will say so. It is better to be a little too formal than overly familiar.
- Thank people for calling. "Thank you" is the most powerful phrase in human relations and it reassures customers that you are interested in serving them.
- Try to avoid technical terms and abbreviations, such as EGR and other terms commonly used in the trade, but that will not be understood by the customer. Try to phrase the technical description by saying that you replaced or serviced a part in the emission control system and include the entire name of the part, such as the "exhaust gas recirculation valve."
- Keep your comments positive and focused toward solving the problem or concern.

FIGURE 4–2 If you smile while talking on the telephone, your attitude will be transmitted to the customer.

TECH TIP

Smile While You Talk

If you smile while talking on the telephone, your voice will reflect a positive and helpful attitude, which customers or vendors will easily recognize over the telephone. ● **SEE FIGURE 4–2.**

- Avoid saying anything that makes people or your shop look unprofessional or uncaring. When dealing with customers, some words are more positive and appropriate to use. Some customer service providers find it helpful to list words to use and words to avoid on a card so that it is available for easy reference.
- Speak clearly and distinctly. Hold the telephone mouthpiece about a half-inch from your lips. Speak naturally and comfortably. Talk to your caller as you would to a friend.
- Move to a quiet area if background noise level is high.

WRITING Writing is communicating by using the written word so that others can understand the intended message. Service technicians are required to document the work that was performed on a vehicle. For some technicians, this is the most difficult part of the service. If writing, be sure it is legible and, if not, print all messages and information. Writing or typing in the description of the steps performed during the diagnosis and repair of the vehicle should be worded as if the technician is talking to the customer. For example, if a coolant leak was repaired by replacing the water pump, the technician should write out the following steps and operations on the work order:

1. Visually verified coolant leaking.
2. Performed a pressure test of the cooling system and located the leak as coming from the water pump.
3. Replaced the water pump, added new coolant, and bled the system of trapped air.
4. Pressure tested the cooling system to verify that the leak was corrected—no leaks found.

READING Reading means the ability to read and comprehend the written word. All service technicians need to be able to read, understand, and follow written instructions and repair procedures. If some words are not understood, use a dictionary or ask another technician for help. For example, a beginning technician read in the service information that the wiring connector was "adjacent to the coolant reservoir." The technician did not understand what the word adjacent meant and found out from another technician that it meant "next or close to."

If reading a note from a customer written in another language you do not understand, try to ask if someone else in the shop can read it for you.

TECH TIP

Use Internet Translation

If the customer is non-English speaking, type the information into a text document and search for a translation on the Internet. Give the copy of the translated document to the customer. The customer request could also be translated into English, if needed, to help the shop understand exactly what the customer is requesting and needs.

TECH TIP

The Internet Is Your Friend

If unsure as to how something works or if you need more detailed information about something, go to *www.google.com*® and search for the topic. Using the Internet can help with locating hard-to-find facts and can even be used to help with a service procedure that you have not done before. For a link to all factory service information, go to the Web site of National Automotive Service Task Force at *www.nastf.org*. Look at the work scheduled for the next day and try to determine as much about the job as possible so you can be prepared the next day to tackle the procedure. Using the International Automotive Technicians Network at *www.iatn.net* is also very helpful for technical information and can help pin down hard-to-find problems.

WHAT HAPPENS THE FIRST DAY?

The first day on the job, someone, usually the shop owner or shop foreman, should:

- Introduce the new technician to key people at the shop.
- Show the new technician the facility, parking, rules, and regulations of the organization.
- Establish the new technician's work area.
- Ask questions of the new technician regarding their skills and talents.

The shop owner or foreman should:

- Review the training tasks that were completed in school.
- Try to direct work to the new technician that covers the new training material.

The first day on the job the beginning technician should:

- Smile and ask questions if needed to clarify procedures and regulations.

TECH TIP

Don't Touch Other Technician's Tools

A beginning technician seldom has all of the tools needed to perform all of the service and repair tasks. A technician's tools are very important. If a tool needs to be borrowed, the beginning technician should ask for permission to borrow a tool. Then when the tool is returned, it should be clean and replaced back exactly where the technician asks for it to be returned.

TECH TIP

Regulated Terms to Use

In some states or areas where automotive service is regulated, such as in California or Michigan, it is important that the term used to describe a labor operation is the term defined by the state agency. This means that some terms used in parts and time guides may not be the same terms used by the state. Always check that the terms used are in compliance with all regulations. Some terms that could be affected include rebuild, repair, overhaul, inspection and R & R (remove and replace), and safety inspection.

- Be prepared to take and pass a drug test.
- Assure the service manager or shop owner that you are serious about a career as an automotive technician.

A work order, also called a **repair order** or **RO**, is assigned to a technician who is best qualified to perform the work. The technician gets the keys and drives the vehicle to an assigned **service bay** (also called a **stall**), performs the proper diagnosis, gets the necessary parts from the parts department, and completes the repair.

After the service work has been performed, the service technician should then fill out the work order and describe what work was performed. These are called the "**three Cs**."

1. **Concern**—Write on the work order what was done to confirm the customer's concern. For example, "Drove the vehicle at highway speed and verified a vibration."
2. **Cause**—The service technician should write the cause of the problem. For example, "Used a scan tool and discovered that cylinder #3 was misfiring."
3. **Correction**—The service technician should write what was done to correct the problem. For example, "Removed the spark plug wire from cylinder number three and by visual inspection found that the boot had been arcing to the cylinder head. Replaced the spark plug wire and verified that the misfire was corrected."

DUTIES OF A SERVICE TECHNICIAN

READING THE WORK ORDER A work order is selected or assigned to a service technician who then performs the listed tasks. The work order should be written so that the technician knows exactly what needs to be done. However, if there is any doubt, the technician should clarify the needed task with the service advisor or the person who spoke to the customer.

TECH TIP

If Late—Call

When running late, you may know that you will be just a few minutes late, but your boss does not how late you will be. If you are going to be late, even by a few minutes, call the shop and let them know. This does not eliminate your being late from your record, but does demonstrate your concern to your service manager and other technicians who are counting on you to being on time to work every day.

TECH TIP

Ask Me about This

A good service advisor will document what the customer wants done on the work order. However, there are times when the explanation and description would take too long and too much space to be practical. In these cases, the wise service advisor simply states on the work order for the service technician to see the service advisor to discuss the situation. The service advisor can write the basic request to document what is needed.

TALKING TO CUSTOMERS The typical service technician usually does not talk directly to a customer except in some smaller shops. However, there may be causes where the technician will be asked to clarify a procedure or repair to a customer. Many technicians do not like to talk to the customers and fear that they may say too much or not enough. If a technician is asked to talk to a customer, try to keep the discussion to the following without being too technical.

- The service technician should repeat the original concern. This is to simply verify to the customer and the technician the goal of the service or repair.
- The cause of the fault should be mentioned. If further diagnostic steps needed to find the cause are requested, discuss the steps followed and the equipment or tools used.
- Discuss what was done to solve the concern, including what part or parts were replaced. This step may also include what other service operations were needed to complete the repair, such as reprogramming the computer.

NOTE: If the customer speaks a foreign language that you do not understand, excuse yourself and locate someone in the shop who can assist you with communicating with the customer. Avoid using slang or abbreviation of technical terms. Ask the person if they understand and be willing to restate, if needed, until the situation is understood. This can often be difficult if discussing technical situations to persons of another language or culture.

ESTIMATING A REPAIR Sometimes a service technician is asked to help create an estimate for the customer. It is usually the responsibility of the service advisor or shop owner to create estimates. The

TECH TIP

Car, Truck, or Vehicle?

When discussing a vehicle with a customer, it is best to avoid creating problems. For example, if a technician asked about a customer's "car," the customer could become concerned because they drive a truck and many owners of trucks do not want their vehicle called a car. Use of the term "vehicle," a generic term, is often recommended when talking to customers to avoid possible concerns.

technician may be helpful by pointing out all of the operations that need to be performed to achieve a repair. The estimate for a repair includes:

- **Parts needed**—This list would also include any gaskets and/or supplies needed. The technician can help identify if extra supplies may be needed.
- **Labor**—A published time guide is usually used, but many times options, such as rear air conditioning or four-wheel drive, may add substantial time to the operation. The technician can help with the estimate by making sure that the options are pointed out to the service advisor or shop owner.

DOCUMENTING THE WORK ORDER The service technician must document the work order. This means that the service technician must write (or type) what all was done to the vehicle, including documenting defective components or conditions that were found in the course of the diagnosis. The documentation is often called "telling the story" and should include the following:

- The test equipment used to diagnose the problem. For example: Used a Tech 2 scan tool to retrieve P0300 random misfire diagnostic trouble code.
- Used a digital multimeter to determine a spark plug wire was defective.
- List what parts or service operations were performed. For example: Replaced the spark plug wire on cylinder number 3. Used a scan tool to clear the diagnostic trouble codes and verify that the engine is operating correctly.

FOLLOWING RECOMMENDED PROCEDURES All service technicians should follow the diagnostic and service procedures specified by the vehicle manufacturer. Following service information procedures includes:

- Follow and document the diagnostic procedure. Writing down the test results helps the customer see all that was involved in the procedure and creates the proper paper trail for future reference, if needed.
- Follow the recommended removal and reinstallation (R & R) procedures. This step helps prevent the possibility of doing harm to the vehicle if an alternative method is attempted.
- Always torque fasteners to factory specifications. This step is very important because under- or overtightened fasteners can cause problems that were not present until after the repair. The wise technician will document torque specifications on the work order.

CUSTOMER PAY **Customer pay (CP)** means that the customer will be paying for the service work at a dealership rather than the warranty. Often the same factory flat-rate number of hours is used to calculate the technician's pay, but customer pay often pays the service technician at a higher rate. For example, a service technician earning $15.00 per flat-rate hour for warranty work may be paid $18.00 per hour for customer-pay work. Obviously, service technicians prefer to work on vehicles that require customer-pay service work rather than factory-warranty service work.

FREQUENTLY ASKED QUESTION

What Can a Service Technician Do to Earn More Money?

Because service technicians are paid on a commission basis (flat-rate), the more work that is completed, the more hours the technician can "turn." Therefore, to earn the most money, the service technician could do the following to increase the amount of work performed:

- Keep up-to-date and learn the latest technical information.
- Practice good habits that help avoid errors or incomplete repairs.
- Learn from experienced and successful fellow technicians and try to approach the repair the same way the successful technician does.
- Purchase the proper tools to do the work efficiently.

NOTE: This does not mean that every technician needs to purchase all possible tools. Purchase only those tools that you know you will need and use.

NONDEALERSHIP FLAT-RATE Technicians who work for independent service facilities or at other nondealership locations use one or both of the following to set rates of pay:

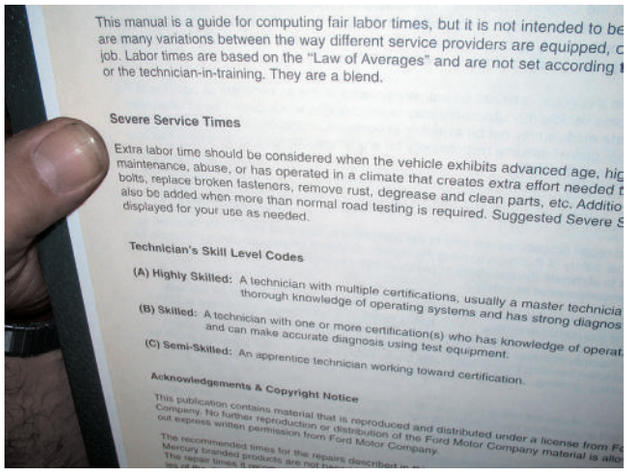
- Mitchell, Motors, or Chilton parts and time guides
- Alldata, Shop-Key, Car-Quest, Auto Value, Mitchell, AC Delco, or other shop management software program.

These guides contain service operation and flat-rate times. Generally, these are about 20% higher (longer) than those specified by the factory flat-rate to compensate for rust or corrosion and other factors of time and mileage that often lengthen the time necessary to complete a repair. Again, the service technician is usually paid a dollar amount per flat-rate hour based on one of these aftermarket flat-rate guides. The guides also provide a list price for the parts for each vehicle. This information allows the service advisor to accurately estimate the total cost of the repair.

FLAGGING A WORK ORDER

When a service technician completes a service procedure or repair, a sticker or notification on the work order indicates the following:

- Technician number (number, rather than a name) is often used not only to shorten the identification, but also to shield the actual identity of the technician from the customer.
- Work order number


This manual is a guide for computing fair labor times, but it is not intended to be
are many variations between the way different service providers are equipped, c
job. Labor times are based on the "Law of Averages" and are not set according t
or the technician-in-training. They are a blend.

Severe Service Times

Extra labor time should be considered when the vehicle exhibits advanced age, hig
maintenance, abuse, or has operated in a climate that creates extra effort needed t
bolts, replace broken fasteners, remove rust, degrease and clean parts, etc. Additio
also be added when more than normal road testing is required. Suggested Severe S
displayed for your use as needed.

Technician's Skill Level Codes

(A) Highly Skilled: A technician with multiple certifications, usually a master technicia
thorough knowledge of operating systems and has strong diagnos

(B) Skilled: A technician with one or more certification(s) who has knowledge of operat
and can make accurate diagnosis using test equipment.

(C) Semi-Skilled: An apprentice technician working toward certification.

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Company. No further reproduction or distribution of the Ford Motor Company material is allo
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The recommended times for the repairs describe
Mercury branded products are not
The repair times

FIGURE 4–3 Note the skill levels of the technician and the extra time that should be added if work is being performed on a vehicle that has excessive rust or other factors as stated in the time guide.

TECH TIP

Technician Skill Level and Severe Service

Most aftermarket service information includes a guideline for the relative level of the technician's skill required to perform the listed service procedures. These include:

A = Highly skilled and experienced technician

B = Skilled technician who is capable of performing diagnosis of vehicle systems

C = Semi-skilled technician who is capable of performing routine service work without direct supervision

Many time guides provide additional time for vehicles that may be excessively rusted due to climate conditions or have been subjected to abuse. Be sure to quote the higher rate if any of these conditions are present on the customer's vehicle. ● **SEE FIGURE 4–3.**

- Actual clock time from a time clock record for certain jobs, as needed
- Amount of time allocated to the repair expressed in hours and tenths of an hour

The application of the service technician's sticker to the back of the work order or completing the details of the repair into the electronic service record is called **flagging the work order**.

NOTE: The actual assignment of the time is often done by another person at the dealership or service facility. This procedure assures that the correct number of hours is posted to the work order and to the technician's ticket.

SUBLET REPAIRS

Often a repair (or a part of a repair) is performed by another person or company outside of the dealership or service facility. For example, an engine needing repair that also has a defective or leaking radiator would be repaired by the original repair facility, but the radiator may be sent to a specialty radiator repair shop. The radiator repair cost is then entered on the work order as a sublet repair.

PARTS REPLACEMENT

Parts replacement is often called **R & R,** meaning **remove and replace**.

NOTE: R & R can also mean remove and repair, but this meaning is generally not used as much now as it used to be when components such as starters and air-conditioning compressors were repaired rather than replaced as an assembly.

R & I is often used to indicate **remove and inspect** to check a component for damage. The old replaced part is often returned for remanufacturing and is called a **core**. A **core charge** is often charged by parts stores when a new (or remanufactured) part is purchased. This core charge usually represents the value of the old component. Because it is needed by the remanufacturer as a starting point for the remanufacturing process, the core charge is also an incentive to return the old part for credit (or refund) of the core charge.

NOTE: Most parts stores today require that all cores be returned in the original boxes. Be sure to place the defective part into the same box that was used for the new or remanufactured part to be sure that the shop gets the proper credit for the core.

ORIGINAL EQUIPMENT PARTS Parts at a new vehicle dealership come either directly from the vehicle manufacturer or a regional dealership. If one dealership purchases from another dealership, the cost of the part is higher, but no waiting is required. If a dealership orders a part from the manufacturer directly, the cost is lower, but there is often a 7- to 10-day waiting period. **Original equipment** parts, abbreviated **OE,** are generally of the highest quality because they have to meet performance and durability standards not required of replacement parts manufacturers.

NOTE: Many service technicians will use only OE parts for certain critical systems, such as fuel injection and ignition system components because, in their experience, even though the price is often higher, the extra quality seems to be worth the cost, not only to the owner of the vehicle, but also to the service technician, who does not have to worry about having to replace the same part twice.

AFTERMARKET PARTS Parts manufactured to be sold for use after the vehicle is made are often referred to as **aftermarket parts** or **renewal parts**. Most aftermarket parts are sold at automotive parts stores or **jobbers**. A jobber or parts retailer usually gets parts from a large regional **warehouse distributor**. The warehouse distributor can either purchase parts directly from the manufacturer or from an even larger central warehouse. Because each business needs to make a profit (typically, 35%), the cost to the end user may not be lower than it is for the same part purchased at a dealership (two-step process instead of the typical three-step process), even though it costs more to manufacture the original equipment part. To determine what a 35% margin increase is for any product, simply divide the cost by 0.65. To illustrate how this works, compare the end cost of a part (part A) from a dealership and a parts store.

Retail Parts Store	New Vehicle Dealership
Manufacturer's selling price = $17.00	Manufacturer's selling price = $25.00
Warehouse distributor's selling price = $26.15 ($17.00 ÷ 0.65 = $26.15)	Parts department selling price = $38.46 ($25.00 ÷ 0.65 = $38.46)
Retail store selling price = $40.23 ($26.15 ÷ 0.65 = $40.23)	

NOTE: The cost of the part to the customer where service work is performed is increased about 35% over the base cost of the part. For example, a part that cost the repair facility $40.23 will be billed to the customer at about $61.00. The retail service customer at the dealer may pay $59.17 ($38.46 ÷ 0.65 = $59.17).

NEW VERSUS REMANUFACTURED PARTS New parts are manufactured from raw materials and have never been used on a vehicle. A remanufactured component (also called **rebuilt**) has been used on a vehicle until the component wore out or failed. A remanufacturer totally disassembles the component, cleans, machines, and performs all the necessary steps to restore the part to a "like new" look and function. If properly remanufactured, the component can be expected to deliver the same length of service as a new component part.

The cost of a remanufactured component is often less than the cost of a new part.

CAUTION: Do not always assume that a remanufactured component is less expensive than a new component. Due to the three-step distribution process, the final cost to the end user (you) may be close to the same!

USED PARTS Used parts offer another alternative to either new or remanufactured parts. The cost of a used component is typically one-half the cost of the component if purchased new. Wrecking and salvage yards use a Hollander manual that lists original equipment part numbers and cost and cross-references them to other parts that are the same.

WORKING WITH A MENTOR

A mentor is a person at the job site who helps the beginning service technician, also called the **trainee**. The word **mentor** comes from Greek mythology. In Homer's *The Odyssey,* Mentor was the faithful companion and friend of Ulysses (Odysseus), the King of Ithaca. Before Ulysses went to the Trojan Wars, he instructed Mentor to stay and take full charge of the royal household. This meant that Mentor had to be father figure, teacher, role model, counselor, trusted advisor, challenger, and encourager to the King's son in order that he become a wise and good ruler.

Therefore, a good definition of a mentor would be, "A highly qualified individual who is entrusted with the protection and development of an inexperienced technician."

A mentor therefore fulfills many roles, such as:

- **Teacher**—helps teach information and procedures
- **Coach**—has the trainee practice service procedures
- **Counselor**—concerned about, but not trained to offer advice on personal life decisions
- **Advisor**—helps with career-type decisions, such as what tools are needed
- **Advocate** (stands up for the trainee)—represents and helps the trainee's concerns be expressed to others
- **Role model**—presents a positive role model every day

QUALIFICATIONS OF A GOOD MENTOR A good mentor should be assigned to a new technician. Qualifications of a good mentor include:

- **Trade proficiency**—The person selected should be a highly skilled technician.
- **Good coaching/mentoring skills and techniques**—The mentor has to have patience and be willing to help the trainee by explaining each step needed to complete a service procedure.

TECH TIP

Work Habit Hints

The following statements reflect the expectations of service managers or shop owners for their technicians:

1. Report to work every day on time. Being several minutes early every day is an easy way to show your service manager and fellow technicians that you are serious about your job and career.
2. If you *must* be late or absent, call your service manager as soon as possible.
3. Keep busy. If not assigned to a specific job, ask what activities the service manager or supervisor wants you to do.
4. Report any mistakes or accidents *immediately* to your supervisor or team leader. *Never* allow a customer to be the first to discover a mistake.
5. Never lie to your employer or to a customer.
6. Always return any borrowed tools as soon as you are done with them and in *clean* condition. *Show* the person you borrowed the tools from that you are returning them to the toolbox or workbench.
7. Keep your work area neat and orderly.
8. Always use fender covers when working under the hood.
9. Double-check your work to be sure that everything is correct.
   a. Remember: "If you are forcing something, you are probably doing something wrong."
   b. Ask for help if unclear as to what to do or how to do it.
10. Do not smoke in a customer's vehicle.
11. Avoid profanity.
12. DO NOT TOUCH THE RADIO! If the radio is turned on and prevents you from hearing noises, turn the volume down. Try to return the vehicle to the owner with the radio at the same volume as originally set.

    NOTE: Some shops have a policy that requires employees to turn the radio off.

13. Keep yourself neatly groomed, including:
    a. Shirttail tucked into pants (unless shirt is designed to be worn outside)
    b. Daily bathing and use of deodorant
    c. Clean hair, regular haircuts, and hair tied back if long
    d. Men: daily shave or keep beard and/or mustache neatly trimmed
    e. Women: makeup and jewelry kept to a minimum

TECH TIP

Adhere to the Times

When starting a new job at a shop or dealership, be sure to ask about the following:

- **What time should I arrive at work?** This may be different than the scheduled work starting time. For example, the work day could start at 8 a.m. but the shop owner or service manager may want all technicians to arrive and start to get ready to work at 7:50 a.m.
- **When is break time?** Breaks may or may not be regularly scheduled and it is important for the beginning technician to know and adhere to break times.
- **When is lunch time?** In some busy shops, the lunch period is staggered to be sure that some technicians are always available for work. Always be willing to adhere to the requested lunch period.

- **Leadership/role model**—The mentor should take pride in being a professional service technician and have high ethical and professional standards.

Mentoring a trainee can be frustrating for an experienced technician. This occurs because the mentor needs to verify almost everything the trainee does until satisfied that competence has been achieved. Even very basic procedures need to be watched, such as hoisting the vehicle, changing the oil and oil filter, plus many other operations. As a result, the time taken to help the beginning technician will reduce the efficiency, and therefore, the pay of the mentor. However, after several weeks, the trainee can start helping the mentor, thereby increasing efficiency.

TEAMWORK

TEAM BUILDING

A team is a group of individuals working together to achieve a common goal. Even shops or service departments that do not use a team system with a group of technicians is still a team. All members of the service department are really part of a team effort working together to achieve efficient vehicle service and customer satisfaction. The key to building a team that works together is selecting employees that are willing to work together. While the shop owner or service manager at a dealership has hiring authority, every technician should consider what is best for the entire group to help increase repeat business and satisfied customers.

LEADERSHIP ROLES

As a technician gains experience, he or she often asks for guidance, not only for technical answers, but also for how to handle other issues in the shop, such as paperwork, use of aftermarket parts, and other issues. Therefore, the more experience the technician has, the more likely he or she will be placed in a leadership and role model position.

GOAL SETTING AND BUSINESS MEETINGS

GOAL SETTING

The wise service technician sets goals to achieve during a career and life. The purpose of goal setting is to focus efforts on improving your personal and professional life. Goals can include aspects of career, physical, family, education, financial and public service. There are many helpful web sites that can be used to help set and track progress toward achieving goals. The hardest part of any goal is to write it down. Until it is written down, a goal is not real.

BUSINESS MEETINGS

All service technicians attend business (shop) meetings. A good business meeting will have the following features:

1. An agenda (list of topics to be discussed) will be given out or displayed.
2. The meeting should start on time and end on time.
3. If someone is to give a report or be asked to do a project, this topic should be discussed with the designated person before the meeting to avoid that person being surprised and made to feel uncomfortable.
4. The meeting should be held following the "Robert's Rule of Order" guidelines.
5. Often meetings include others from inside or outside the company or shop, so try to look your best and smile to make the best impression.

ADVANCEMENT SKILLS

The job of a service technician becomes more valuable to the shop or dealership if work can be accomplished quickly and without any mistakes. Therefore, being careful to avoid errors is the first consideration for any service technician. Then, with experience, the speed of accomplishing tasks can and will increase.

More than speed is needed to become a master technician. It requires problem solving and critical thinking skills, too. While beginning technicians are usually not required to diagnose problems, troubleshooting skills are very important toward becoming a master technician. Most master technicians follow a plan that includes:

1. Always verify the customer concern.
2. Perform a thorough visual inspection and check for possible causes of the problem, including damage from road debris or accidents.
3. Use a scan tool and check for stored diagnostic trouble codes (DTCs).
4. Check service information for technical service bulletins (TSBs).
5. Check service information and follow all diagnostic trouble charts.
6. Locate and correct the root cause of the problem.
7. Verify the repair and document the work order.

The hardest part of the diagnostic process is to locate the root cause of the problem. The process of analyzing and evaluating information and making a conclusion is called **critical thinking**.

HOUSEKEEPING DUTIES

A professional service technician is usually responsible for keeping his or her work area clean and tidy. Good housekeeping includes all of the following:

- **Clean floor**—If coolant or oil is spilled on the floor during a repair procedure, it should be cleaned before starting another job.

TECH TIP

Keeping "Things" Off the Floor

To make cleaning easier and for a more professional shop appearance, keep only those items on the floor that have to be on the floor and find a place off the floor for all other items.

TECH TIP

Look at the Shop from a Customer's Point of View

To determine if the shop and other technicians look professional, step outside and enter the shop through the same door as a customer. Now look around. Look at the shop and the other technicians. Does the shop give the appearance of a professional service facility? If not, try to improve the look by asking the shop owner or service manager to do the same thing in an attempt to create a more professional-looking shop.

- **Tool box**—Keep work area and tool box clean and organized.
- **Items kept off the floor**—It is easy to allow parts and other items to be stored in and around the toolbox and in corners. However, having items on the floor makes keeping the area clean and neat-looking very difficult.
- **Keep areas around exits and fire extinguishers clear.** Do not store or place parts, boxes, or shop equipment, such as floor jacks and testers, near exits and fire extinguishers. This helps ensure that people can have easy access to exits or the fire extinguishers in the event of an emergency.
- **Avoid spraying chemicals in the air.** To help keep the air in the shop clean, keep the use of spray chemicals, such as brake cleaner, to a minimum and avoid spraying where it could result in affecting the air others breathe.

JOB EVALUATION

In most jobs, there is an evaluation of performance. A beginning technician is not expected to perform at the same level as an experienced master technician but should be able to do the following:

- **Follow instructions.** The trainee should follow the instructions of the mentor or service manager. This includes making sure that the person is notified when the job has been completed and if there were any problems.
- **Do no harm.** Avoid exerting a lot of force to door panels or other components to help avoid breaking clips or components. Always use the right tool for the job. For example, never use pliers to remove a bolt or nut, which could round off the flats of the fastener. Always think before acting, "Am I going to hurt something by doing this?"
- **Keep a neat and clean appearance.** It is normal to get dirty while performing service work on a vehicle. However, after each job is completed or even during the repair, try to keep as clean as possible. A professional service technician should try to maintain a professional appearance at all times. For example, if coolant or automatic transmission fluid (ATF) gets onto a shirt or pants, the wise technician would change into a clean uniform before working on another vehicle. Many shop owners and service managers recommend that shirttails always be tucked into pants to ensure a more professional appearance.
- **Ask that your work be checked.** Even though the trainee thinks that the service or repair was done correctly, until confidence has been established, it is wise to ask to have all work double-checked.

TECH TIP

Write It Down

If a technician needs to have another technician finish a repair due to illness or some other reason, be sure to write down exactly what was done and what needs to be done. Verbal communication, while very effective, is often not a good way to explain multiple steps or processes. For example, the other technician could easily forget that the oil had not yet been added to the engine, which could cause a serious problem if the engine were to be started. If in doubt, write it down.

TECH TIP

Don't Cover Up Mistakes

Everyone makes mistakes. While a damaged component or vehicle is never a good thing to have happen, the wise technician should notify the service manager or other person in charge as soon as a problem or accident occurs. Only then can work begin to correct the problem. If a mistake is hidden, eventually someone will learn about the error and then people will not think it was wise to ignore or to cover up the situation.

CAUTION: Never allow a mistake to reach the customer. It is only a problem if it cannot be corrected.

FORMAL EVALUATION The mentor and/or service manager may or may not conduct a written evaluation on a regular basis. If a written evaluation is performed, this is called a **formal evaluation**. A formal evaluation usually includes many points of discussion. See the sample evaluation form.

INFORMAL EVALUATION In many cases, a beginning technician's activities are simply observed and noted, which is a type of **informal evaluation**. Both are usually done and both can influence the technician's pay.

NOTE: Most employees are fired from a job as the result of not being able to get along with others, rather than a lack of technical skills.

Technician Evaluation

Please check one of the spaces to the left of each characteristic which best expresses your judgment of the technician:

ATTITUDE-APPLICATION TO WORK
_____outstanding in enthusiasm
_____very interested and industrious
_____average in diligence and interest
_____somewhat indifferent
_____definitely not interested

DEPENDABILITY
_____completely dependable
_____above average in dependability
_____usually dependable
_____sometimes neglectful or careless
_____unreliable

QUALITY OF WORK
_____excellent
_____very good
_____average
_____below average
_____very poor

MATURITY
_____shows confidence
_____has good self-assurance
_____average maturity
_____seldom assertive
_____timid
_____brash

ABILITY TO LEARN
_____learned work exceptionally well
_____learned work readily
_____average in understanding work
_____rather slow in learning
_____very slow to learn

INITIATIVE
_____proceeds well on his or her own
_____proceeds independently at times
_____does all assigned work
_____hesitates
_____must be pushed frequently

RELATIONS WITH OTHERS
_____exceptionally well accepted
_____works well with others
_____gets along satisfactorily
_____has difficulty working with others
_____works very poorly with others

QUANTITY OF WORK
_____usually high output
_____more than average
_____normal amount
_____below average
_____low output, slow

JUDGMENT
_____exceptionally mature
_____above average
_____usually makes the right decision
_____often uses poor judgment

ATTENDANCE
_____regular
_____irregular

PUNCTUALITY
_____regular
_____irregular

REVIEW QUESTIONS

1. What factors are part of being a professional service technician?
2. What is a mentor?
3. A formal evaluation could include what items?
4. What are the three Cs?
5. What should be included on the work order after the repair has been completed?

CHAPTER QUIZ

1. Professionalism includes which factor?
   a. Keeping your word
   b. Becoming a teammate with your coworkers
   c. Apologizing if you are wrong
   d. All of the above
2. Types of communications include _____.
   a. verbal
   b. written
   c. nonverbal
   d. All of the above

3. The three Cs include ____, ____, and ____.
   a. correction, correct torque, and customer name
   b. concern, cause, and correction
   c. cause, cost, and caller name
   d. captured data, cause, and cost (of the repair)
4. When documenting the work order, what things should be listed?
   a. The test equipment used in the diagnosis
   b. The test procedure that was followed
   c. The parts that were replaced
   d. All of the above
5. Technician A says that customer-pay rate is sometimes higher than the factory flat-rate. Technician B says that the factory flat-rate times are usually longer (given more time) compared to aftermarket flat-rate time guides. Which technician is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technicians A and B
   d. Neither Technician A nor B
6. Housekeeping duties of a technician can include _____.
   a. cleaning the floor
   b. keeping the work area clean and organized
   c. keeping items off the floor whenever possible
   d. All of the above
7. A repair shop pays $22.50 for an aftermarket water pump. With a shop margin of 35%, how much will the customer be charged for the water pump?
   a. $22.50
   b. $22.50 plus 10%
   c. $34.62
   d. $38.50
8. Which of the following is a characteristic of good business meetings?
   a. The meetings should start on time and can be easily extended beyond the decided end time.
   b. The meetings should not include anyone outside the company or shop.
   c. The meetings should follow “Robert’s Rules of Order.”
   d. The agenda of the meeting should be displayed at the end.
9. A mentor performs all of the following *except* _____.
   a. helps guide diagnosis of a problem
   b. signs paychecks
   c. offers advice on how to do a job
   d. advises on professional behavior
10. Which of the following characteristics is evaluated under “maturity,” on a technician evaluation form?
    a. Completely dependable
    b. Has difficulty working with others
    c. Very slow to learn
    d. Seldom assertive

chapter 5

TECHNICIAN CERTIFICATION

LEARNING OBJECTIVES:

After studying this chapter, the reader should be able to:

Describe the automotive certifications offered by the ASE tests.
Explain how to qualify and register for the ASE certification tests.
Describe the type of test questions asked on the certification tests.
Explain how to prepare to take the ASE certification tests.
Describe Canada's apprenticeship and certification requirements.
Describe vehicle manufacturer certification requirements.
Explain why re-certification is necessary and how technicians can obtain it.

KEY TERMS: ASE (National Institute for Automotive service Excellence) 36 • Distractor 37 • Except-type questions 38 • Experience-based question 37 • IP certification 41 • Key 37 • Least-likely-type question 38 • Most-likely-type question 38 • Multiple-choice question 37 • Technician A and B question 37 • Work experience 37

AUTOMOBILE TECHNICIAN CERTIFICATION TESTS

Even though individual franchises and companies often certify their own technicians, there is a nationally recognized certificate organization, the **National Institute for Automotive Service Excellence**, better known by its abbreviation, **ASE.** ● **SEE FIGURE 5–1.**

ASE is a nonprofit association founded in 1972, and its main goal is to improve the quality of vehicle service through standardized testing and volunteer certification.

FIGURE 5–1 A stack of ASE certification patches usually sewn on the sleeves of a work shirts.

WHAT AREAS OF VEHICLE SERVICE ARE COVERED BY THE ASE TESTS?

Automobile test service areas include:

- **A1** Engine Repair
- **A2** Automatic Transmission/Transaxle
- **A3** Manual Drive Train and Axles
- **A4** Suspension and Steering
- **A5** Brakes
- **A6** Electrical/Electronic Systems
- **A7** Heating and Air Conditioning
- **A8** Engine Performance

If a technician takes and passes all eight of the automobile tests and has achieved two or more years of work experience, ASE will award the designation of *ASE Certified Master Automobile Technician*. Contact ASE for other certification areas.

QUALIFYING AND REGISTERING FOR THE ASE TESTS

HOW CAN I CONTACT ASE?

ASE	Toll-free: 1-877-ASE-TECH (273-8324)
101 Blue Seal Drive, SE	1-703-669-6600
Suite 101	Web site: *www.ase.com*
Leesburg, VA 20175	

WHEN ARE THE TESTS GIVEN AND WHERE?

The ASE written tests are given at hundreds of test sites throughout the year for online testing.

WHAT DO I HAVE TO DO TO REGISTER? You can register for the ASE tests in three ways:

1. Mail in the registration form that is in the registration booklet.
2. Register online at www.ase.com.
3. Telephone at (866) 427-3273

Call ASE toll-free at 1-888-427-3273, or visit the Web site for details about cost and dates.

HOW MANY YEARS OF WORK EXPERIENCE ARE NEEDED? ASE requires that you have two or more years of full-time, hands-on **working experience** either as an automobile, truck, truck equipment, or school bus technician, engine machinist, or in collision repair, refinishing, or damage analysis and estimating for certification, except as noted below. If you have *not* previously provided work experience information, you will receive a Work Experience Report Form with your admission ticket. You *must* complete and return this form to receive a certificate.

SUBSTITUTIONS FOR WORK EXPERIENCE. You may receive credit for up to one year of the two-year work experience requirement by substituting relevant formal training in one, or a combination, of the following:

High School Training: Three full years of training, either in automobile/truck/school bus repair or in collision repair, refinishing, or damage estimating, may be substituted for one year of work experience.

Post-High School Training: Two full years of post-high school training in a public or private trade school, technical institute, community or four-year college, or in an apprenticeship program may be counted as one year of work experience.

Short Courses: For shorter periods of post-high school training, you may substitute two months of training for one month of work experience.

You may receive full credit for the two-year work experience requirement with the following:

Completion of Apprenticeship: Satisfactory completion of either a three- or four-year bona fide apprenticeship program.

ARE THERE ANY HANDS-ON ACTIVITIES ON THE ASE TEST? No. All ASE tests are written using objective-type questions, meaning that you must select the correct answer from four possible alternatives.

WHO WRITES THE ASE QUESTIONS? All ASE test questions are written by a panel of industry experts, educators, and experienced ASE-certified service technicians. Each question is reviewed by the committee and it is checked for the following:

- **Technically accurate.** All test questions use the correct terms and only test for vehicle manufacturer's recommended service procedures. Slang is not used, nor are any aftermarket accessories included on the ASE test.
- **Manufacturer neutral.** All efforts are made to avoid using vehicle or procedures that are manufacturer specific, such as to General Motors vehicles or Toyotas. A service technician should feel comfortable about being able to answer the questions regardless of the type or brand of vehicle.
- **Logical answers.** All effort is made to be sure that all answers (not just the correct answers) are possible. While this may seem to make the test tricky, it is designed to test for real knowledge of the subject.
- **Random answer.** All efforts are made to be sure that the correct answers are not always the longest answer or that one letter, such as **c,** is not used more than any other letter.
- **Experience-based questions.** The questions asked are generally not knowledge-based questions, but rather require experience to answer correctly. Specifications are not asked for, but instead a question as to what would most likely occur if the unit is out-of-specifications could be asked.

TAKING THE ASE TESTS

KEY AND DISTRACTOR The **key** is the correct answer. As part of the test writing sessions, the committee is asked to create other answers which sound feasible, but are not correct. These incorrect answers are called **distractors**.

WHAT TYPES OF QUESTIONS ARE ASKED ON THE ASE TEST? All ASE test questions are objective. This means that there will not be questions where you will have to write an answer. Instead, all you have to do is select one of the four possible answers and place a mark in the correct place on the score sheet.

- **Multiple-choice questions.** This type of question has one correct (or mostly correct) answer (called the key) and three incorrect answers. A multiple-choice question example: What part of an automotive engine does not move?

  a. Piston
  b. Connecting rod
  c. Block
  d. Valve

  The correct answer is **c** (block). This type of question asks for a specific answer. Answer **a** (piston), **b** (connecting rod), and **d** (valve) all move during normal engine operation. The best answer is **c** (block) because even though it may vibrate, it does not move as the other parts do.

- **Technician A and Technician B questions.** This type of test question is generally considered to be difficult but really they are just two true and false questions together. A situation or condition is usually stated and two technicians (A and B) say what they think could be the correct answer and you must decide which technician is correct.

  a. Technician A only
  b. Technician B only
  c. Both Technicians A and B
  d. Neither Technician A nor B

  The best way to answer this type of question is to carefully read the question and consider Technician A and Technician B answers to be solutions to a true or false question. If Technician A is correct, mark on the test by Technician A the letter T for true. (Yes, you can write on the test.) If Technician B is also correct, write the letter T for true by Technician B. Then mark **c** on your test score sheet, for both technicians are correct.

  Example:

  Two technicians are discussing an engine that has lower than specified fuel pressure. Technician A says that the fuel pump could be the cause. Technician B says that the fuel pressure regulator could be the cause. Which technician is correct?

  a. Technician A only
  b. Technician B only
  c. Both Technicians A and B
  d. Neither Technician A nor B

Analysis:

Is Technician A correct? The answer is yes because if the fuel pump was defective, the pump pressure could be lower than specified by the vehicle manufacturer. Is Technician B correct? The answer is yes because a stuck open regulator with a weak spring could be the cause of lower than specified fuel pressure. The correct answer is therefore **c.** (Both Technicians A and B are correct.)

- **Most-likely-type questions.** This type of question asks which of the four possible items listed is the most likely to cause the problem or symptom. This type of question is often considered to be difficult because recent experience may lead you to answer the question incorrectly because, even though it is possible, it is not the "most likely."

Example:

Which of the items below is the most likely to cause blue exhaust at engine start?

a. Valve stem seals
b. Piston rings
c. Clogged PCV valve
d. A stuck oil pump regulator valve

Analysis:

The correct answer is **a** because valve stem seals are the most likely to cause this problem. Answer **b** is not correct because even though worn piston rings can cause the engine to burn oil and produce blue exhaust smoke, it is not the most likely cause of blue smoke at engine start. Answers **c** and **d** are not correct because even though these items could contribute to the engine burning oil and producing blue exhaust smoke, they are not the most likely.

- **Except-type questions.** ASE will sometimes use a question that includes answers that are all correct except one. You have to determine which of the four answers is not correct.

Example:

A radiator is being pressure tested using a hand-operated tester. This test will check for leaks in all except:

a. Radiator
b. Heater core
c. Water pump
d. Evaporator

Analysis:

The correct answer is **d** because the evaporator is not included in the cooling system and will not be pressurized during this test. Answers **a** (radiator), **b** (heater core), and **c** (water pump) are all being tested under pressure exerted on the cooling system by the pressure tester.

- **Least-likely-type questions.** Another type of question asked on many ASE tests is a question that asks which of the following is least likely to be the cause of a problem or symptom. In other words, all of the answers are possible, but it is up to the reader to determine which answer is the least likely to be correct.

Example:

Which of the following is the least likely cause of low oil pressure?

a. Clogged oil pump screen
b. Worn main bearing
c. Worn camshaft bearing
d. Worn oil pump

Analysis:

The correct answer is **c** because even though worn camshaft bearings can cause low oil pressure, the other answers are more likely to be the cause.

QUESTIONS OFTEN ASKED

SHOULD I GUESS IF I DON'T KNOW THE ANSWER? Yes. ASE tests simply record the correct answers, and by guessing, you will have at least a 25% (one out of four) chance. If you leave the answer blank, it will be scored as being incorrect. Instead of guessing entirely, try to eliminate as many of the answers as possible as not being very likely. If you can eliminate two out of the four, you have increased your chance of guessing to 50% (two out of four).

IS EACH TEST THE SAME EVERY TIME I TAKE IT? No. ASE writes many questions for each area and selects from this "test bank" for each test session. You may see some of the same questions if you take the same test in the Spring and then again in the Fall, but you will also see many different questions.

CAN I SKIP QUESTIONS I DON'T KNOW AND COME BACK TO ANSWER LATER? Yes. You may skip a question if you wish, but be sure to mark the question and return to answer the question later. It is often recommended to answer the question or guess and go on with the test so that you do not run out of time to go back over the questions.

HOW MUCH TIME DO I HAVE TO TAKE THE TESTS? Each computer-based test will allow enough time for completion, usually between one and two hours for each test. The time allowed for each test is available on the ASE Web site.

WILL I HAVE TO KNOW SPECIFICATIONS AND GAUGE READINGS? Yes and no. You will be asked the correct range for a particular component or operation and you must know about what the specification should be. Otherwise, the questions will state that the value is less than or greater than the allowable specification. The question will deal with how the service technician should proceed or what action should be taken.

CAN I TAKE A BREAK DURING THE TEST? Yes, you may use the restroom after receiving permission from the proctor of the test site.

CAN I LEAVE EARLY IF I HAVE COMPLETED THE TEST(S)? Yes, you may leave quietly after you have completed the test(s).

WHAT PERCENTAGE DO I NEED TO ACHIEVE TO PASS THE ASE TEST? While there is no exact number of questions that must be answered correctly in each area, an analysis of the test results indicate that the percentage needed to pass varies from 61% to 69%. Therefore, in order to pass the Engine Repair (A1) ASE certification test, you will have to answer about 39 questions correct out of 60. In other words, you can miss about 21 questions and still pass.

TECH TIP

Never Change an Answer

Some research has shown that your first answer is most likely to be correct. It is human nature to read too much into the question rather than accept the question as it was written.

WHAT HAPPENS IF I DO NOT PASS? DO I HAVE TO WAIT A YEAR BEFORE TRYING AGAIN? No. If you fail to achieve a passing score on any ASE test, you can take the test again at the next testing session.

DO I HAVE TO PAY ANOTHER REGISTRATION FEE IF I ALREADY PAID IT ONCE? Yes. The registration fee is due at every test session in May or November whether you select to take one or more ASE tests. Therefore, it is wise to take as many tests as you can at each test session.

WILL I RECEIVE NOTICE OF WHICH QUESTIONS I MISSED? You will receive a summary of your test results, which shows how many questions you missed in each category, but not individual questions.

WILL ASE SEND ME THE CORRECT ANSWERS TO THE QUESTIONS I MISSED SO I WILL KNOW HOW TO ANSWER THEM IN THE FUTURE? No. ASE will not send you the answers to test questions.

PREPARING FOR THE ASE TESTS

START NOW Even if you have been working on vehicles for a long time, taking an ASE certification test can be difficult. The questions will not include how things work or other "textbook" knowledge. The questions are based on "real-world" diagnosis and service. The tests may seem tricky to some because the wrong answers are designed to be similar to the correct answer.

If this is your first time taking the test or you are going to recertify, start now to prepare. Allocate time each day to study.

PRACTICE IS IMPORTANT Many service technicians do not like taking tests. As a result, many technicians rush through the test to get the pain over with quickly. Also, many service technicians have lots of experience on many different vehicles. This is what makes them good at what they do, but when an everyday problem is put into a question format (multiple choice), the answer may not be as clear as your experience has taught you.

KEYS TO SUCCESS The keys to successful test taking include:

- Practice answering similar-type questions.
- Carefully read each question two times to make sure you understand the question.
- Read each answer.
- Pick the best answer.
- Avoid reading too much into each question.
- Do not change an answer unless you are sure that the answer is definitely wrong.
- Look over the glossary of automotive terms for words that are not familiar to you.

The best preparation is practice, practice, and more practice. This is where using the ASE Test Prep practice tests can help.

PROCEDURE FOR GETTING ASE CERTIFIED

STEP 1 Go to *www.ase.com* and register to take the test(s). They are offered most days and at various times, which change frequently because sessions fill up and other times and days become open.

STEP 2 Arrive at the test site prepared to take the test. Bring a photo ID and the test registration paper.

STEP 3 Before being assigned a computer on which you will take the test, the following will be performed:

1. You will be issued a locker where you will place everything that is in your pockets except for your photo ID.
2. You will be asked to turn all of your pockets inside out to verify that there is nothing left in your pockets.
3. You will be asked to stand on a line with your arms outstretched and a sensor wand will be used to check for anything on your body. You will be asked to turn around and again the wand will be used to check your other side.
4. You will then be asked to lift up your pants so the inspector can see your ankles.

STEP 4 After being checked, you will be given your photo ID and the key to the locker.

STEP 5 The inspector will ask you to wait while he/she starts the computer that you will use for your test.

NOTE: The testing area is under video surveillance at all times.

STEP 6 After the computer has been setup, you will be escorted to the computer cubical and instructed to place your photo ID on a holder and the key to your locker on the desk in front of you.

STEP 7 At this time, you click on the screen and the test opens. Click start and the questions are displayed. Each test has a time limit and the time remaining is displayed on the upper left corner. The number of the test question is shown at the upper right corner of the screen, such as 17/50.

HINT: If you are spending too much time on one question, skip it and go on to keep on task. The program will display and allow you to go back and answer the question you skipped if there is time remaining at the end.

STEP 8 After the last question has been displayed and answered, you will be shown a screen showing any skipped questions. You can click to exit and you have completed the test. Exit the test area.

STEP 9 When you exit the testing area, you will be asked to sign out and show your photo ID. Your test score will be printed out and given to you before you retrieve your belongings and then you are free to leave the testing center.

EIGHT ASE AREAS

1. Engine Repair (A1) ASE Task List

Content Area	Questions in Test	Percentage of Test
A. General Engine Diagnosis	15	28%
B. Cylinder Head and Valve Train Diagnosis and Repair	10	23%
C. Engine Block Diagnosis and Repair	10	23%
D. Lubrication and Cooling Systems Diagnosis and Repair	8	14%
E. Fuel, Electrical, Ignition, and Exhaust Systems Inspection and Service	7	12%
Total	**50**	**100%**

2. Automatic Transmission/Transaxles (A2) ASE Task List

Content Area	Questions in Test	Percentage of Test
A. General Transmission/Transaxle Diagnosis **1.** Mechanical/Hydraulic Systems (11) **2.** Electronic Systems (14)	25	50%
B. In-Vehicle Transmission/Transaxle Repair	12	16%
C. Off-Vehicle Transmission/ Transaxle Repair **1.** Removal, Disassembly, and Assembly (3) **2.** Gear Train, Shafts, Bushings, Oil Pump, and Case (4) **3.** Friction and Reaction Units (4)	13	26%
Total	**50**	**100%**

3. Manual Drive Train and Axles (A3) ASE Task List

Content Area	Questions in Test	Percentage of Test
A. Clutch Diagnosis and Repair	6	15%
B. Transmission Diagnosis and Repair	7	18%
C. Transaxle Diagnosis and Repair	7	20%
D. Drive (Half) Shaft and Universal Joint/Constant Velocity (CV) Joint Diagnosis and Repair (Front and Rear Wheel Drive)	5	13%
E. Rear Axle Diagnosis and Repair **1.** Ring and Pinion Gears (3) **2.** Differential Case Assembly (2) **3.** Limited Slip Differential (1) **4.** Axle Shafts (1)	7	17%
F. Four-Wheel Drive Component Diagnosis and Repair	8	17%
Total	**40**	**100%**

4. Suspension and Steering (A4) ASE Task List

Content Area	Questions in Test	Percentage of Test
A. Steering Systems Diagnosis and Repair	12	30%
B. Suspension Systems Diagnosis and Repair	12	30%
C. Wheel Alignment Diagnosis, Adjustment, and Repair	11	28%
D. Wheel and Tire Diagnosis and Service	5	12%
Total	**40**	**100%**

5. Brakes (A5) ASE Task List

Content Area	Questions in Test	Percentage of Test
A. Hydraulic, Power Assist, and Parking Brake Systems Diagnosis and Repair Master Cylinder Lines and Hoses Valves and Switches Bleeding, Flushing, and Leak Testing Power Assist Units Parking Brake	19	43%
B. Drum Brake Diagnosis and Repair	5	11%
C. Disc Brake Diagnosis and Repair	11	24%
D. Electronic Brake Control Systems: Antilock Brake System (ABS), Traction Control System (TCS), and Electronic Stability Control System (ESC) Diagnosis and Repair	10	22%
Total	**45**	**100%**

6. Electrical Systems (A6) ASE Task List

Content Area	Questions in Test	Percentage of Test
A. General Electrical/Electronic System Diagnosis	13	26%
B. Battery and Starting System Diagnosis and Repair	9	18%
C. Charging System Diagnosis and Repair	5	10%
D. Lighting Systems Diagnosis and Repair	6	12%
E. Instrument Cluster and Driver Information Systems Diagnosis and Repair	6	12%
F. Body Electrical Systems Diagnosis and Repair	11	22%
Total	**50**	**100%**

7. Heating and Air Conditioning (A7) ASE Task List

Content Area	Questions in Test	Percentage of Test
A. Heating, Ventilation, A/C (HVAC) and Engine Cooling System Service, Diagnosis, and Repair	21	42%
B. Refrigeration System Component Diagnosis and Repair	10	20%
C. Operating Systems and Related Controls Diagnosis and Repair	19	38%
Total	**50**	**100%**