



7

Service Information and Work Orders

After studying this chapter, you will be able to:

- Describe the different types of service manuals.
- Find and use the service manual index and contents sections.
- Explain the different kinds of information and illustrations used in a service manual.
- Describe the three basic types of troubleshooting charts found in service manuals.
- Explain how to use computer-based service information.
- Correctly answer ASE certification test questions concerning service information.

Vehicles contain thousands of parts. Many of these parts are assembled to close tolerances (exacting standards) and require precise assembly and adjustment. Sometimes a technician needs specific technical information to properly repair a vehicle. In these cases, the technician must refer to service information in the form of printed service manuals or computer-based service data. See **Figure 7-1**.



Figure 7-1. Service manuals and computer-based service data are essential reference tools for today's automotive technicians.

Service Manuals

Service manuals, also called **shop manuals**, are books with detailed information on how to repair a vehicle. They have step-by-step procedures, specifications, diagrams, part illustrations, and other data for each vehicle model. Every service facility normally has a set of service manuals. They help technicians with difficult repairs.

Service manuals are written in concise technical language and are heavily illustrated. They are designed to be used by well-trained technicians. A service manual is one of a technician's *most important tools*.

Service Manual Types

There are various types of service manuals. These include manufacturer's manuals, specialized manuals,

and general repair manuals. It is important to understand the differences between each type.

Manufacturer's manuals, also called **factory manuals**, are published by a vehicle's manufacturer. Each manual covers a specific vehicle produced by the manufacturer during a given model year.

Specialized manuals cover only specific repair areas. They usually come in several volumes, each covering one section of the vehicle. One may cover engines and another body components or electrical systems. Specialized manuals are published by vehicle manufacturers or aftermarket companies. Aftermarket companies are suppliers other than a vehicle manufacturer.

General repair manuals are published by companies other than the major vehicle makers. Some of these companies include Mitchell Manuals, Motor Manuals, and

Chilton Manuals. General repair manuals are similar to manufacturer's manuals, but they are usually *not* as detailed. They may include data on all American cars produced over a period of several years. Other general repair manuals only cover foreign cars, light trucks, or large trucks. It is often too costly for a service facility to buy service manuals from every vehicle manufacturer. Instead, they may buy two or three general repair manuals for all types of vehicles. These manuals summarize the most important and most needed information.

Service Manual Sections

A service manual is divided into sections, such as general information, engine, transmission, and electrical. See **Figure 7-2**. To effectively use a service manual, you need to understand these sections and how they are organized.

The **general information section** of a service manual helps you with a vehicle's identification, basic maintenance, lubrication, and other general subjects. An

important topic in this section is the **vehicle identification number (VIN)**. The VIN provides data about the car. It is commonly used when ordering parts. The number, which is usually found on a plate located on the vehicle's dashboard, contains a code. The manual explains what each part of this number code means. Look at **Figure 7-3**. The VIN tells you engine type, transmission type, and other useful information.

The **repair sections** of a service manual cover the vehicle's major systems. These sections explain how to recognize and diagnose problems and inspect, test, and repair each system. One page may describe how to remove the engine. Another page might explain how to disassemble the engine. Specifications such as bolt tightening limits, capacities, clearances, and operating temperatures are given in the repair sections. These specifications are commonly used during service and repair operations. The repair section also refers to special tools that are needed for a limited number of repair tasks. These tools may be pictured at the end of the manual section. Refer to **Figure 7-4**.












INTRODUCTION	
How to Use This Manual This manual is divided into 16 sections. The first page of each section is marked with a black tab that lines up with one of the thumb index tabs on the front and back covers. You can quickly find the first page of each section without looking through a full table of contents. The symbols printed at the top corner of each page can also be used as a quick reference system. Each section includes: 1. A table of contents, or an exploded view index showing: <ul style="list-style-type: none"> • Parts disassembly sequence. • Bolt torques and thread sizes. • Page references to descriptions in text. 2. Disassembly/assembly procedures and tools. 3. Inspection. 4. Testing/troubleshooting. 5. Repair. 6. Adjustments.	General Info 
	Special Tools 
	Specifications 
	Maintenance 
	Engine 
	Engine Electrical 
	Cooling 
	Fuel 
	Emission Controls 
	Transaxle 
Special Information <div>  WARNING Indicates a strong possibility of severe personal injury or loss of life if instructions are not followed. </div> <div> CAUTION: Indicates a possibility of personal injury or equipment damage if instructions are not followed. </div> <div> NOTE: Gives helpful information to make the job easier. </div> <div> CAUTION: Detailed descriptions of <i>standard</i> workshops procedures, safety principles, and service operations are not included. Please note that this manual does contain warnings and cautions against some specific service methods which could cause PERSONAL INJURY, or could damage a vehicle or make it unsafe. Please understand that these warnings cannot cover all conceivable ways. </div>	

Figure 7-2. A service manual is divided into several repair sections. Be sure to read the introduction and any special information. (Honda)

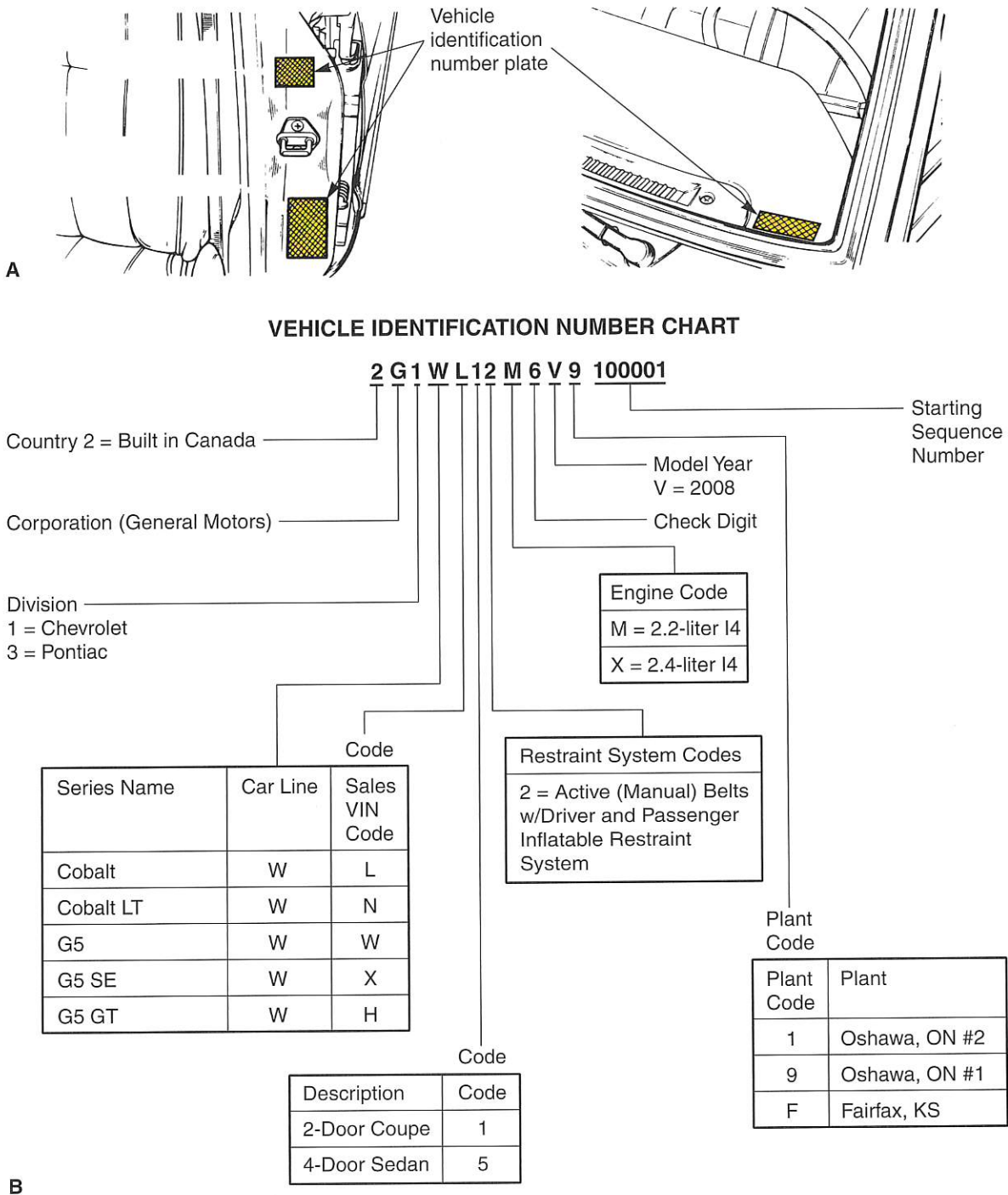


Figure 7-3. A—The vehicle identification number (VIN) can be located on the door, on the dashboard, or in the engine compartment. B—The VIN is a code. A service manual will explain the code, as shown. (Subaru and General Motors)

Service Manual Illustrations

Various types of *service illustrations* are used to supplement the written information in a service manual. Some show how to measure part wear, while others show how to install a part. Others show an exploded, or disassembled,

view of parts. When using a service manual, you will find the illustrations essential for a full understanding of the procedures and specifications. They may show you what parts look like, how they fit together, where leaks might occur, or how a part works. **Figure 7-5** shows some common types of service manual illustrations.

Tool Number & Description	Illustration
49-0813-310 Centering tool, clutch disc	
49-0500-330 Installer, transition bearing	
49-0259-440 Turning holder, mainshaft	
49-0862-350 Guide, shift fork assembly	

Figure 7-4. The service manual will explain any special tool numbers. Note these special tools for clutch and transmission repairs. (Mazda)

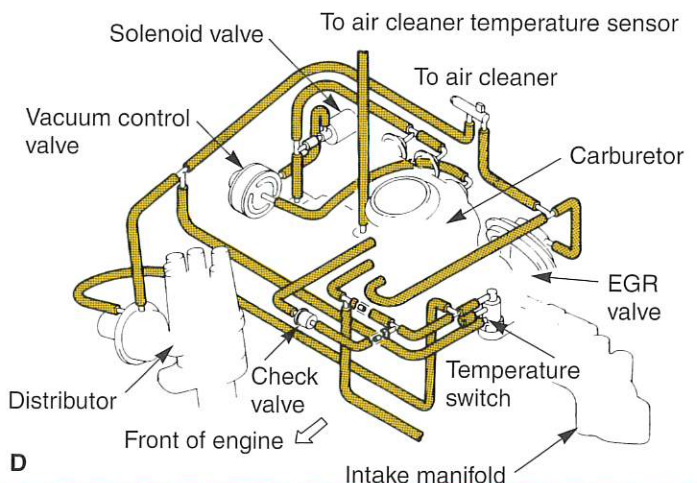
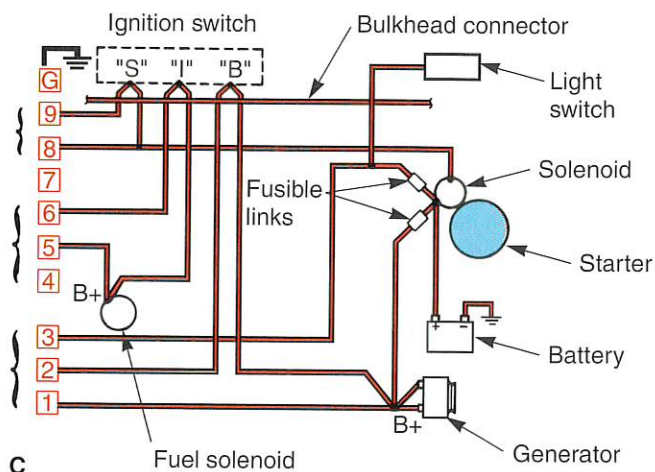
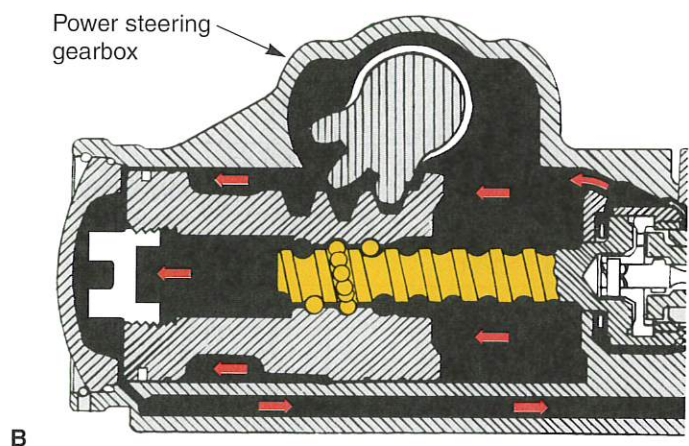
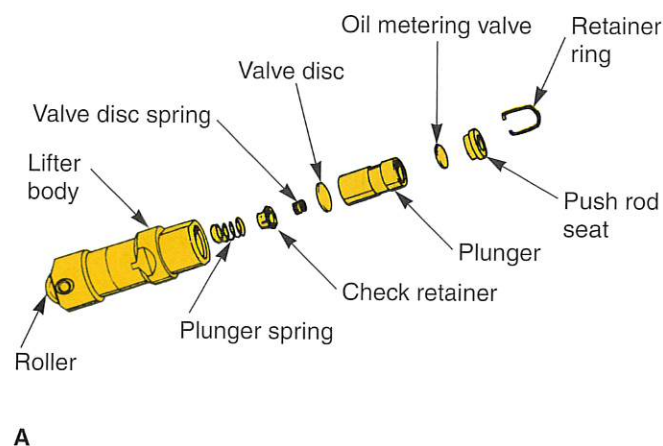


Figure 7-5. Typical service manual illustrations. A—An exploded view shows how parts fit together. B—An operational illustration shows how parts function. C—A wiring diagram shows how wires connect to components. D—A vacuum diagram shows how hoses connect to components. (General Motors and Subaru)

Service Manual Diagrams

Diagrams are drawings used when working with electrical circuits, vacuum hoses, and hydraulic circuits. They represent how wires, hoses, passages, and parts connect together. **Wiring diagrams** show how the wiring connects to the electrical components. See **Figure 7-5C**. This subject is covered later in the text.

Vacuum diagrams help the technician determine how vacuum hoses connect to the engine and vacuum-operated devices, **Figure 7-5D**. **Hydraulic diagrams** show how a fluid, usually oil, flows in a circuit or part. They are helpful in understanding how a component operates or how to troubleshoot problems. Hydraulic diagrams are commonly given for automatic transmissions and power steering systems.

Service Manual Abbreviations

Abbreviations are letters that stand for an entire word. They are often used in service manuals. Sometimes,

abbreviations are explained as soon as they are used. They may also be explained at the front or rear of the manual in a chart. This textbook uses only universally accepted

abbreviations. It does *not* use abbreviations that only apply to one manufacturer. **Figure 7-6** gives some of the abbreviations recommended by SAE International.

Term	Abbreviations	Term	Abbreviations
Accelerator pedal	AP	Ignition control	IC
Air cleaner	ACL	Ignition control module	ICM
Air conditioning	A/C	Inertia fuel shutoff	IFS
Automatic transaxle	A/T	Intake air	IA
Automatic transmission	A/T	Intake air temperature	IAT
Barometric pressure	BARO	Knock sensor	KS
Battery positive voltage	B+	Malfunction indicator lamp	MIL
Camshaft position	CMP	Manifold absolute pressure	MAP
Carburetor	CARB	Manifold differential pressure	MDP
Charge air cooler	CAC	Manifold surface temperature	MST
Closed loop	CL	Manifold vacuum zone	MVZ
Closed throttle position	CTP	Mass airflow	MAF
Clutch pedal position	CPP	Mixture control	MC
Continuous fuel injection	CFI	Multiport fuel injection	MFI
Continuous trap oxidizer	CTOX	Nonvolatile random access memory	NVRAM
Crankshaft position	CKP	On-board diagnostic	OBD
Data link connector	DLC	Open loop	OL
Diagnostic test mode	DTM	Oxidation catalytic converter	OC
Diagnostic trouble code	DTC	Oxygen sensor	O2S
Direct fuel injection	DFI	Park/neutral position	PNP
Distributor ignition	DI	Periodic trap oxidizer	PTOX
Early fuel evaporation	EFE	Positive crankcase ventilation	PCV
EGR temperature	EGRT	Power steering pressure	PSP
Electrically erasable programmable read only memory	EEPROM	Powertrain control module	PCM
Electronic ignition	EI	Programmable read only memory	PROM
Engine control	EC	Pulsed secondary air injection	PAIR
Engine control module	ECM	Random access memory	RAM
Engine coolant level	ECL	Read only memory	ROM
Engine coolant temperature	ECT	Relay module	RM
Engine modification	EM	Scan tool	ST
Engine speed	RPM	Secondary air injection	AIR
Erasable programmable read only memory	EPROM	Sequential multiport fuel injection	SFI
Evaporative emission	EVAP	Service reminder indicator	SRI
Exhaust gas recirculation	EGR	Smoke puff limiter	SPL
Fan control	FC	Supercharger	SC
Flash electrically erasable programmable read only memory	FEEPROM	Supercharger bypass	SCB
Flash erasable programmable read only memory	FEPRM	System readiness test	SRT
Flexible fuel	FF	Thermal vacuum valve	TVV
Fourth gear	4GR	Third gear	3GR
Fuel level sensor	----	Three way + oxidation catalytic converter	TWC+OC
Fuel pressure	----	Three way catalytic converter	TWC
Fuel pump	FP	Throttle body	TB
Fuel trim	FT	Throttle body fuel injection	TBI
Generator	GEN	Throttle position	TP
Governor	----	Torque converter clutch	TCC
Governor control module	GCM	Transmission control module	TCM
Ground	GND	Transmission range	TR
Heated oxygen sensor	HO2S	Turbocharger	TC
Idle air control	IAC	Vehicle speed sensor	VSS
Idle speed control	ISC	Voltage regulator	VR
		Volume airflow	VAF
		Warm up oxidation catalytic converter	WU-OC
		Warm up three way catalytic converter	WU-TWC
		Wide open throttle	WOT

Figure 7-6. SAE-recommended abbreviations.

Diagnostic Charts

Diagnostic charts, or **troubleshooting charts**, give steps for finding and correcting problems in an automobile. These steps may include inspection, testing, measurement, and repair. If the source of the problem is hard to find, a diagnostic chart should be used. It will guide you to the most common causes of specific problems. There are four basic types of diagnostic charts. These are tree, block, illustrated, and component location charts.

A **tree diagnosis chart** provides a logical sequence for what should be inspected or tested when trying to solve a repair problem, **Figure 7-7**. For instance, if a horn will not work, the top of the tree chart may tell you to check the horn's fuse. Then, if the fuse is good, it may have you measure the voltage going to the horn. You can work your way down the "tree" until the problem is fixed.

A **block diagnosis chart** lists conditions, causes, and corrections in columns, **Figure 7-8**. The most common cause is the top listing. For example, if an engine overheats, loss of coolant appears at the top of the "causes" column. Check the coolant level. If this is the problem, fill the radiator and check for leaks. If the coolant level is OK, go to the next listing.

An **illustrated diagnosis chart** uses pictures, symbols, and words to guide the technician through a

sequence of tests. This type of troubleshooting chart is illustrated in **Figure 7-9**. If an engine oil pressure gauge shows low oil pressure, for example, the chart shows you exactly what to do, step by step, until the problem is corrected. This type of diagnosis chart not only tells you what to do, but it shows you how to do it.

A **component location chart** shows where various parts are located on the vehicle. This type of chart is often used for the engine compartment. The chart helps locate the numerous sensors, relays, fuses, and other components housed in this area. See **Figure 7-10**.

Using a Service Manual

To use a service manual, follow these basic steps:

1. Locate the proper service manual. Some manuals come in sets or volumes that cover different repair areas. Others cover all subjects and all car makes. If you are working on engines, find the manual that gives the most information for the type of engine being serviced.
2. Turn to the table of contents or the index to quickly find the needed information. *Never* thumb through a manual looking for a subject.
3. Use the page listings given at the beginning of each repair section. Most manuals have a small

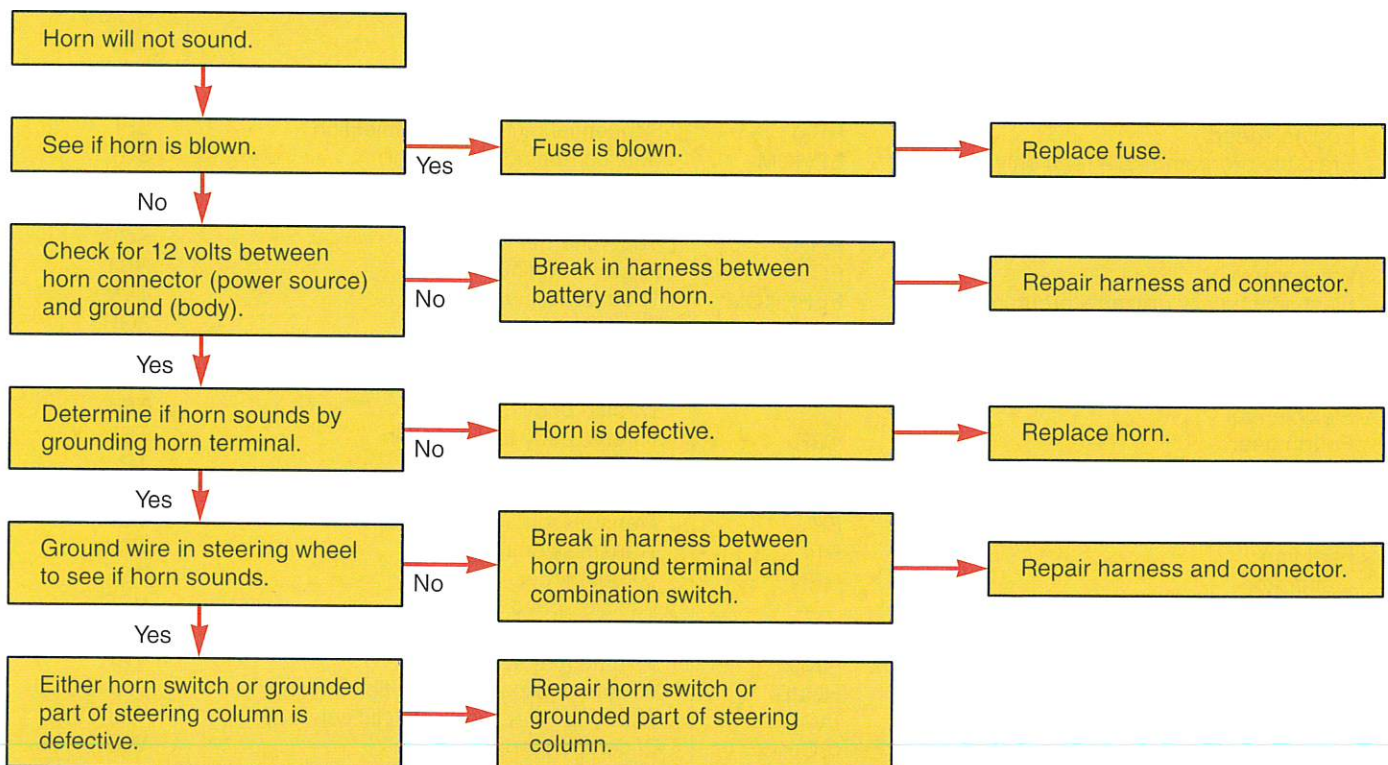


Figure 7-7. A tree diagnosis chart starts at the top and guides you through repair operations.

Condition	Possible Cause	Correction
<ul style="list-style-type: none"> Loss of coolant. 	<ul style="list-style-type: none"> Pressure cap and gasket. Exhaust leakage. Internal leakage. 	<ul style="list-style-type: none"> Inspect, wash gasket, and test. Replace only if cap will not hold pressure test specifications. Pressure test system. <ul style="list-style-type: none"> Inspect hose, hose connections, radiator, edges of cooling system gaskets, core plugs, drain plugs, transmission oil cooler lines, water pump, heater system components. Repair or replace as required. Check for obvious restrictions. Check torque of head bolts. Retorque if necessary. Disassemble engine as necessary— check for cracked intake manifold, blown head gaskets, warped head or block gasket surfaces, cracked cylinder head, or engine block.
<ul style="list-style-type: none"> Engine overheats. 	<ul style="list-style-type: none"> Low coolant level. Loose fan belt. Pressure cap. Radiator or A/C condenser obstruction. Closed thermostat. Fan drive clutch. Ignition. Temperature gauge or cold light. Engine. Exhaust system. 	<ul style="list-style-type: none"> Fill as required. Check for coolant loss. Adjust. Test. Replace if necessary. Remove bugs and leaves. Test. Replace if necessary. Test. Replace if necessary. Check timing and advance. Adjust as required. Check electrical circuits and repair as required. Check water pump and block for blockage. Check for restrictions.
<ul style="list-style-type: none"> Engine fails to reach normal operating temperature. 	<ul style="list-style-type: none"> Thermostat stuck open. Temperature gauge or cold light inoperative. 	<ul style="list-style-type: none"> Test. Replace if necessary. Check electrical circuits and repair as required. Refer to electrical section.

Figure 7-8. A block diagnosis chart lists conditions, causes, and corrections in columns. Read to the right to match a condition with possible causes and corrections. (Ford)

table of contents at the beginning of each section.

- Read the procedures carefully. A service manual gives highly detailed instructions. You must *not* overlook any step or the repair may fail.
- Study the manual illustrations closely. The pictures in a service manual contain essential information. They cover special tools, procedures, torque values, and other data essential to the repair.



Tech Tip!

Service manual layouts and features vary. The best way to learn their use is to practice finding information in them. For example, on your lunch hour, look up specific service information in several types of manuals. Compare the organization and differences in each manual. This will help you find data more quickly when on the job.

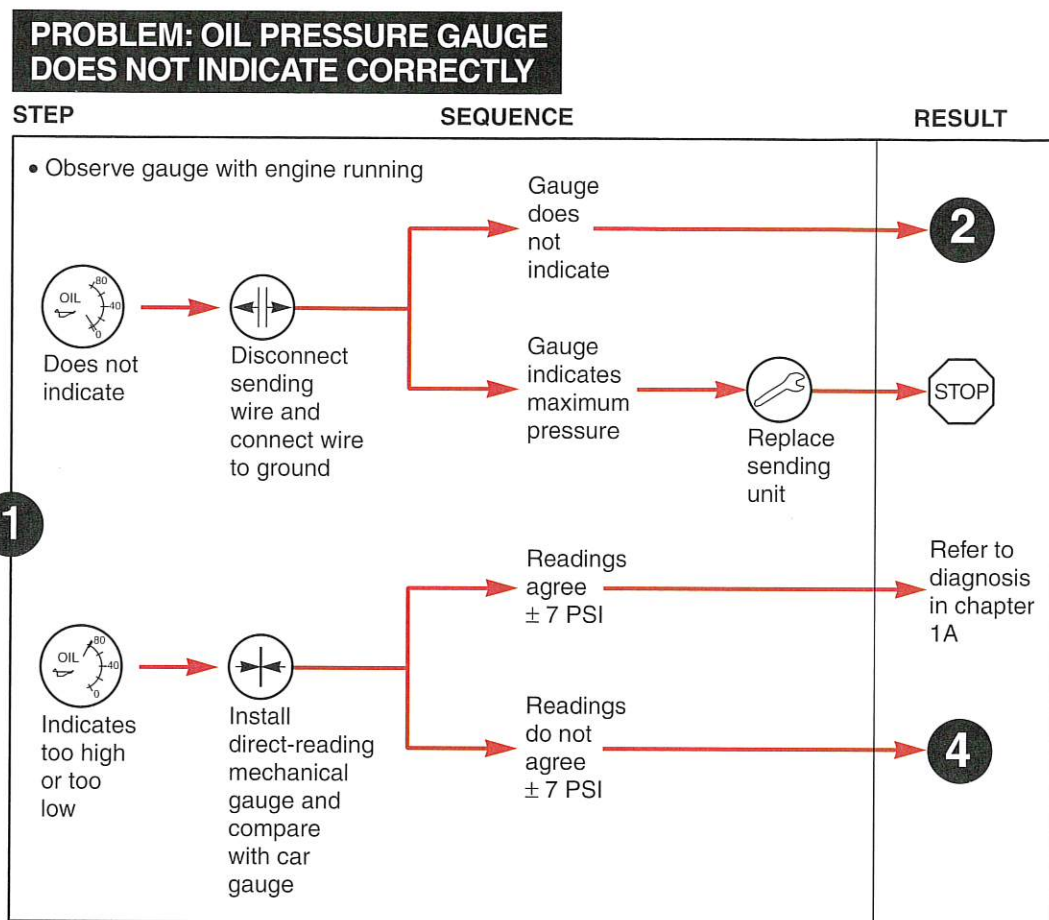


Figure 7-9. An illustrated diagnosis chart uses small illustrations and symbols to show how to find and correct a problem.

Service Publications

A service manual is just one kind of book that contains technical information on a vehicle. Other types, called **service publications**, include owner's manuals, flat rate manuals, and technical bulletins.

Owner's Manual

An **owner's manual** is a small booklet given to the purchaser of a new vehicle. It contains basic information on starting the engine, maintaining the car, and operating vehicle accessories.

Flat Rate Manual

A **flat rate manual** is a publication that lists the flat rate times for a variety of repairs. **Flat rate time** is the average amount of time it will take a technician to do a specific repair. Many shops use flat rate time when calculating the labor charges for a repair. Flat rate time is multiplied by the shop's hourly labor rate to find the labor charge in dollars. Using the flat rate manual, you will be able to give the customer a cost estimate before beginning the actual repair.

Technical Bulletins

Technical bulletins help the technician stay up-to-date with recent technical changes, repair problems, and other service-related information. Usually only a few pages long, these publications are mailed to the service manager, who passes them along to the technicians. Technical bulletins are published by auto manufacturers and equipment suppliers.



Tech Tip!

Technical bulletins often describe common troubles with certain makes of vehicles. This allows you to check these common problems first.

Technical Assistance Hotlines

A number of automobile and equipment manufacturers have established **technical assistance hotlines**, which allow technicians to speak directly to specially trained technical support personnel. These individuals have an extensive knowledge of the manufacturers' products and often have access to advanced troubleshooting

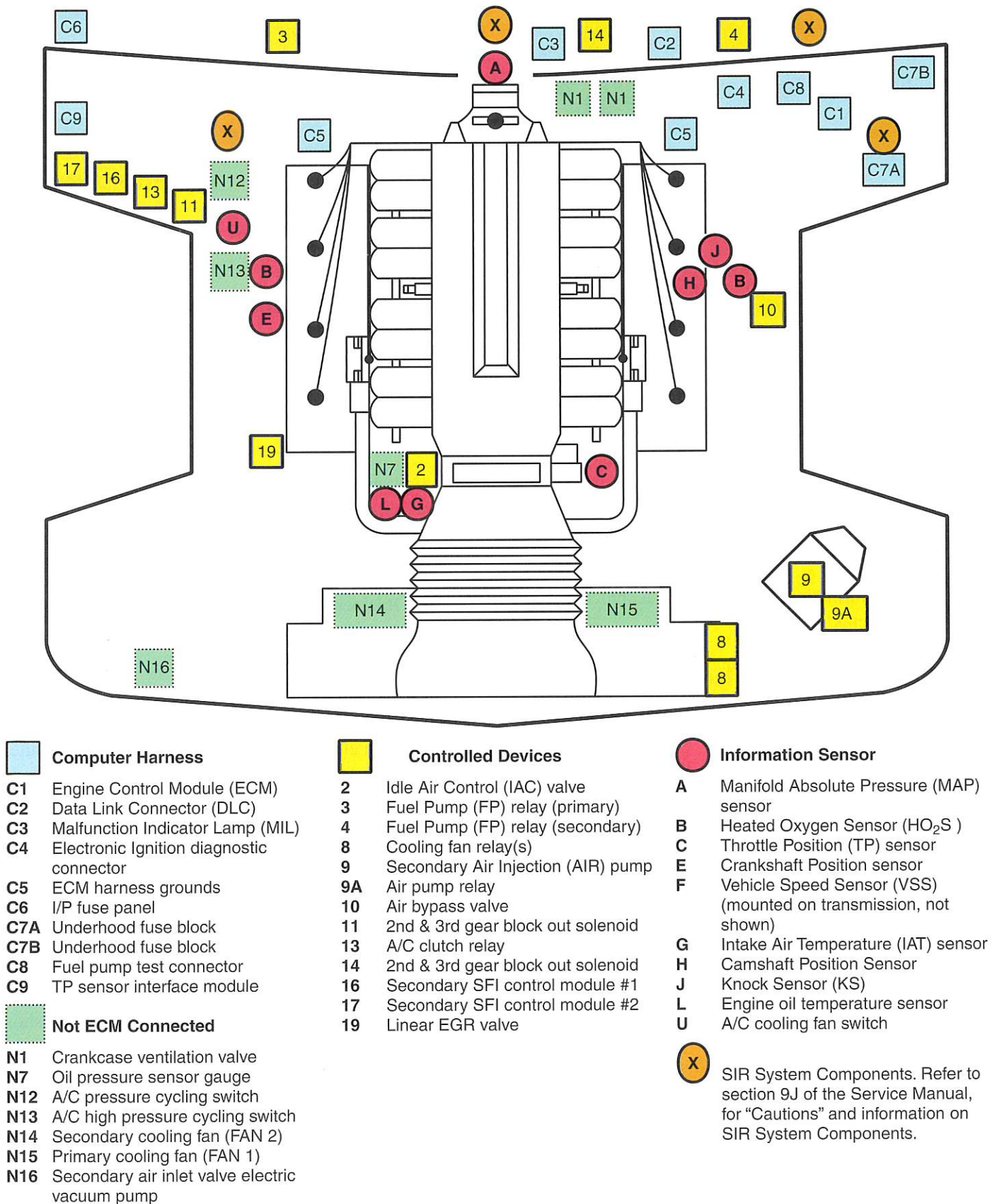


Figure 7-10. Study the location of the parts shown in a component location chart. The service manual will often give this type of chart for the exact make and model car being serviced. (Chevrolet)

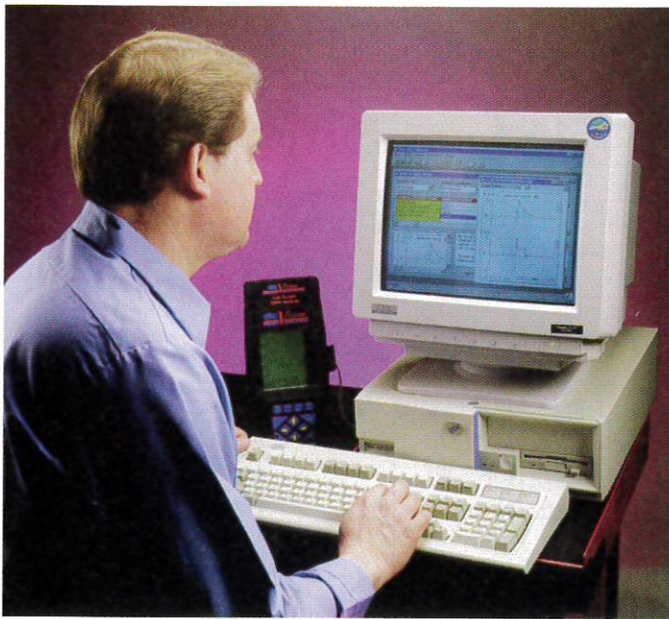


Figure 7-11. A computer is now a commonly used tool of many technicians. It can help with everything from ordering parts to troubleshooting hard-to-find problems. (OTC)

and service information. They can help technicians solve difficult problems.

Computer-Based Service Data

Computer-based service data is information stored or retrieved electronically using a personal computer. Automotive service information can be stored on computer's hard drive, CD-ROMs, DVDs, or a computer network. A computer can find and retrieve this information much more quickly than a technician paging through a service manual. Modern repair shops are using computer-based service data everyday, **Figure 7-11**.

A **CD**, or **compact disc**, is a computer storage device with the capacity to hold large amounts of data in digital form. One CD can hold the information from an entire set of service manuals.



Note

Some service information is available on DVD. A DVD (digital versatile disc) is a digital storage device that can hold almost seven times more information than a conventional CD.

Computer systems can be used to store and access a variety of service-related information, including:

1. Repair procedures.
2. Repair illustrations.
3. Part prices.

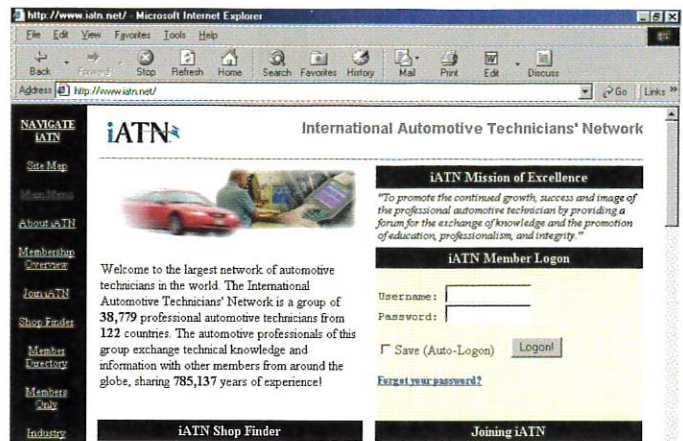


Figure 7-12. The Internet can be a valuable source of information. Some Internet sites, such as the International Automotive Technician's Network, allow technicians to share their technical knowledge. (iATN)

4. Labor times.
5. Safety rules.
6. Troubleshooting charts.
7. Diagnostic trouble code charts.
8. Business software for billing and ordering parts.

Online Services

Various **online services** allow the technician to access technical information using the Internet. The **Internet** is an electronic network that enables a computer to communicate with other computers via a telephone line, cable connection, or satellite dish.

Online services provide information on common vehicle troubles, manufacturers' recalls, new products, technician training, etc. They also allow repair facilities to find information that is not available in the manuals or electronic media they have on hand. See **Figure 7-12**.

Work Orders

A **work order**, also called a repair order or shop ticket, is form used by technicians to record information about a vehicle that is being serviced. It is often used as the invoice for the customer. In some cases, a work order is used when preparing a repair estimate.

Generally, the shop's service writer or manager initiates the work order by filling in customer and vehicle information, as well as a written description of the problems or symptoms described by the customer. The service writer also has the customer sign work order, authorizing the shop to repair the vehicle.

The work order is then given to the technician, who uses the information on the form as a starting point when servicing or repairing the vehicle. The technician records the services or repairs that were completed, as well as the flat rate time or the actual time required to complete the repairs.

When repairs are complete, the technician must calculate the total labor charge for the repair. The flat rate time or the actual time required to complete the repair is multiplied by the shop's labor rate. For example, if the flat rate time is 5 hours and the labor rate is \$50 per hour, the total labor charge would be \$250.

Next, the technician calculates the total charges for the parts used during the repair. Most work orders have a separate section for listing the repair parts and their prices. In most cases, the part prices are based on a percentage markup of the wholesale part prices. For example, if the shop markup is 30% on a part with a wholesale price of \$25.00, the price charged to the customer is \$32.50 (\$25.00 \times 130%). If there were outside services performed on the vehicle, the costs of these services must be added to the work order. Some shops charge an environmental fee for the disposal of hazardous wastes (oil, batteries, etc.). This charge must also be included on the work order.

Finally, the technician must calculate tax for the parts and then total the bill by adding parts, labor, supplies, fees, and taxes to arrive at the final amount for the repair.

Workplace Skills

In the past, printed service manuals provided most of the repair information used by the automotive technicians. Today, computer-based service information is replacing printed information. One advantage of computer-based service information is the ability to conduct a keyword search. You can instantly find and display repair procedures, illustrations, diagnosis charts, and other important information about the vehicle being serviced.

Summary

- Service manuals are books with detailed information on how to repair a vehicle. They have step-by-step procedures, specifications, diagrams, part illustrations, and other data for each model of vehicle.
- Manufacturer's manuals are published by vehicle manufacturers.

- A service manual is divided into sections, such as general information, engine, transmission, and electrical.
- The VIN is a number code that indicates engine type, transmission type, and other useful information.
- Various types of service illustrations are used to supplement the written information in a service manual.
- Diagrams are drawings used when working with electrical circuits, vacuum hoses, and hydraulic circuits.
- Abbreviations are letters that stand for entire words.
- A flat rate manual is used to calculate how much labor to charge the customer for a repair.
- Computer-based service data is information stored or retrieved using a personal computer instead of a book or publication.

Important Terms

Service manuals	Owner's manual
Manufacturer's manuals	Flat rate manual
Specialized manuals	Flat rate time
General repair manuals	Technical bulletins
Vehicle identification number (VIN)	Technical assistance hotlines
Service illustrations	Computer-based service data
Abbreviations	Compact disc (CD)
Diagnostic charts	Online services
Component location chart	Internet
Service publications	Work order

Review Questions—Chapter 7

Please do not write in this text. Place your answers on a separate sheet of paper.

1. What is a service manual?
2. Which of the following is *not* a service manual containing information on car repairs?
 - (A) Manufacturer's manual.
 - (B) Owner's manual.
 - (C) General repair manual.
 - (D) All of the above.
3. Explain the purpose of the following.
 - (A) Wiring diagrams.
 - (B) Vacuum diagrams.
 - (C) Hydraulic diagrams.

4. List ten common abbreviations and explain them.
5. The following is *not* a common type of diagnostic chart.
 - (A) Track diagnosis chart.
 - (B) Tree diagnosis chart.
 - (C) Block diagnosis chart.
 - (D) Illustrated diagnosis chart.
6. Write the five basic steps for using a service manual.
7. A _____ manual is used to calculate how much labor to charge for a repair.
8. _____ help the technician stay up-to-date with recent technical changes, repair problems, and other service related information.
9. Define *computer-based service data*.
10. The network that allows a computer to communicate with other computers is called the _____.
 - (A) Modem
 - (B) CD-ROM
 - (C) Internet
 - (D) None of the above.

ASE-Type Questions

1. Each of the following is a type of service manual *except*:
 - (A) *general repair manuals*.
 - (B) *owner's manuals*.
 - (C) *factory manuals*.
 - (D) *specialized manuals*.
2. Technician A says VIN information is generally found in the repair section of a service manual. Technician B says VIN information is generally located in the general information section of a service manual. Who is right?
 - (A) *A only*.
 - (B) *B only*.
 - (C) *Both A and B*.
 - (D) *Neither A nor B*.
3. A technician who is having trouble finding the cause of a vehicle problem should refer to the following first.
 - (A) *Service bulletin*.
 - (B) *Troubleshooting chart*.
 - (C) *Spec sheet*.
 - (D) *Repair procedures*.

4. Which of the following should be used when calculating the cost of a repair?
 - (A) *Troubleshooting chart*.
 - (B) *Service bulletin*.
 - (C) *Flat rate manual*.
 - (D) *Cold rate manual*.
5. Technician A says technical bulletins describe common problems encountered on specific vehicles. Technician B says technical bulletins are often published by independent repair facilities. Who is right?
 - (A) *A only*.
 - (B) *B only*.
 - (C) *Both A and B*.
 - (D) *Neither A nor B*.

Activities—Chapter 7

1. Obtain a flat rate manual and a parts catalog from your instructor and prepare a bill for replacement of a fuel pump on a vehicle of your choice. Check the manual for the amount of labor involved. Then, consult the parts catalog for the cost of the part. Add up the costs plus the state tax for your state. (Figure labor cost at \$48/hour.)
2. Using computer-based service information, demonstrate to your class how to find the procedure for removal and replacement of a part chosen by your instructor.