

Pearson New International Edition

Diagnosis of Automotive
Electrical Systems
James D. Halderman
Sixth Edition

Table of Contents

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Diagnosis of Automotive Electrical Systems James D. Halderman Sixth Edition

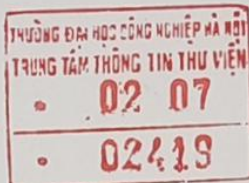


Table of Contents

1. Electrical Fundamentals

James D. Halderman

2. Electrical Circuits and Ohm's Law

James D. Halderman

3. Series, Parallel, and Series-Parallel Circuits

James D. Halderman

4. Circuit Testers and Digital Meters

James D. Halderman

5. Oscilloscopes and Graphing Multimeters

James D. Halderman

6. Automotive Wiring and Wire Repair

James D. Halderman

7. Wiring Schematics and Circuit Testing

James D. Halderman

8. Capacitance and Capacitors

James D. Halderman

9. Magnetism and Electromagnetism

James D. Halderman

10. Electronic Fundamentals

James D. Halderman

11. Computer Fundamentals

James D. Halderman

12. CAN and Network Communications

James D. Halderman

13. Batteries

James D. Halderman

1

13

21

35

55

65

81

99

105

119

137

145

163

14. Battery Testing and Service	173
James D. Halderman	
15. Cranking System	189
James D. Halderman	
16. Cranking System Diagnosis and Service	203
James D. Halderman	
17. Charging System	219
James D. Halderman	
18. Charging System Diagnosis and Service	233
James D. Halderman	
19. Lighting and Signaling Circuits	255
James D. Halderman	
20. Driver Information and Navigation Systems	279
James D. Halderman	
21. Horn, Wiper, and Blower Motor Circuits	305
James D. Halderman	
22. Accessory Circuits	321
James D. Halderman	
23. Airbag and Pretensioner Circuits	357
James D. Halderman	
24. Audio System Operation and Diagnosis	373
James D. Halderman	
25. On-Board Diagnosis	391
James D. Halderman	
26. Temperature Sensors	401
James D. Halderman	
27. Throttle Position (TP) Sensors	413
James D. Halderman	
28. MAP/BARO Sensors	421
James D. Halderman	
29. Mass Air Flow Sensors	431
James D. Halderman	
30. Oxygen Sensors	439
James D. Halderman	
31. Ignition System Operation and Diagnosis	457
James D. Halderman	

ELECTRICAL FUNDAMENTALS

32. Fuel Pumps, Lines, and Filters James D. Halderman	481
33. Fuel-Injection Components and Operation James D. Halderman	499
34. Electronic Throttle Control System James D. Halderman	513
35. Fuel-Injection System Diagnosis and Service James D. Halderman	523
36. Vehicle Emission Standards and Testing James D. Halderman	545
37. Emission Control Devices Operation and Diagnosis James D. Halderman	557
38. Scan Tools and Engine Performance Diagnosis James D. Halderman	585
39. Hybrid Safety and Service Procedures James D. Halderman	605
40. Fuel Cells and Advanced Technologies James D. Halderman	621
English Glossary James D. Halderman	637
Index	649

ELECTRICAL FUNDAMENTALS

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

- Prepare for ASE Electrical/Electronic Systems (A6) certification test content area "A" (General Electrical/Electronic System Diagnosis).
- Define electricity.
- Explain the units of electrical measurement.
- Discuss the relationship among volts, amperes, and ohms.
- Explain how magnetism is used in automotive applications.

KEY TERMS: Ammeter • Ampere • Atom • Bound electrons • Conductors • Conventional theory • Coulomb • Electrical potential • Electricity • Electrochemistry • Electromotive force (EMF) • Electron theory • Free electrons • Insulators • Ion • Neutral charge • Ohmmeter • Ohms • Peltier effect • Photoelectricity • Piezoelectricity • Positive temperature coefficient (PTC) • Potentiometer • Resistance • Rheostat • Semiconductor • Static electricity • Thermocouple • Thermoelectricity • Valence ring • Volt • Voltmeter • Watt

INTRODUCTION

The electrical system is one of the most important systems in a vehicle today. Every year more and more components and systems use electricity. Those technicians who really know and understand automotive electrical and electronic systems will be in great demand.

Electricity may be difficult for some people to learn for the following reasons.

- It cannot be seen.
- Only the results of electricity can be seen.
- It has to be detected and measured.
- The test results have to be interpreted.

ELECTRICITY

BACKGROUND Our universe is composed of matter, which is *anything* that has mass and occupies space. All matter is made from slightly over 100 individual components called *elements*. The smallest particle that an element can be broken into and still retain the properties of that element is known as an **atom**. ● SEE FIGURE 1.

DEFINITION **Electricity** is the movement of electrons from one atom to another. The dense center of each atom is called the nucleus. The nucleus contains:

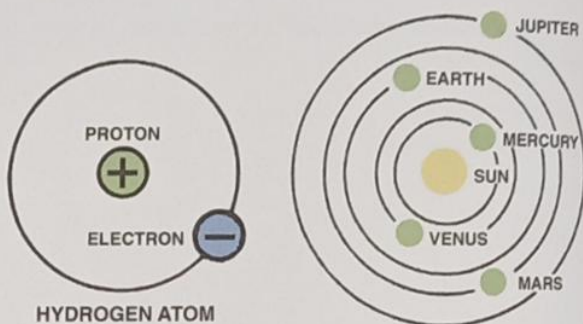


FIGURE 1 In an atom (left), electrons orbit protons in the nucleus just as planets orbit the sun in our solar system (right).

- *Protons*, which have a positive charge
- *Neutrons*, which are electrically neutral (have no charge)

Electrons, which have a negative charge, surround the nucleus in orbits. Each atom contains an equal number of electrons and protons. The physical aspect of all protons, electrons, and neutrons are the same for all atoms. It is the *number* of electrons and protons in the atom that determines the material and how electricity is conducted. Because the number of negative-charged electrons is balanced with the same number of positive-charged protons, an atom has a **neutral charge** (no charge).

NOTE: As an example of the relative sizes of the parts of an atom, consider that if an atom were magnified so that the nucleus were the size of the period at the end of this sentence, the whole atom would be bigger than a house.