




---

---

---

---

---

---

---

---




---

---

---

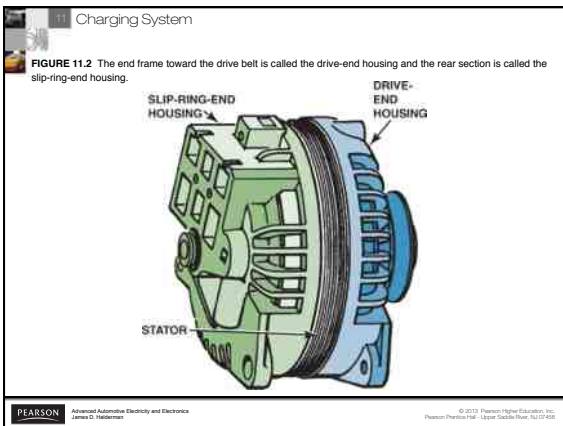
---

---

---

---

---




---

---

---

---

---

---

---

---

11 Charging System

**FIGURE 11.3** An OAP on a Chevrolet Corvette alternator.

PEARSON Advanced Automotive Electricity and Electronics  
James D. Halperin © 2013 Pearson Higher Education, Inc.  
Pearson Education, Inc., Upper Saddle River, NJ 07458

---

---

---

---

---

---

---

---

---

---

11 Charging System

**FIGURE 11.4** An exploded view of an overrunning pulley showing all of the internal parts.

PEARSON Advanced Automotive Electricity and Electronics  
James D. Halperin © 2013 Pearson Higher Education, Inc.  
Pearson Education, Inc., Upper Saddle River, NJ 07458

---

---

---

---

---

---

---

---

---

---

11 Charging System

**TECH TIP**

**Alternator Horsepower and Engine Operation**  
Many techs know and recall how much power certain accessories require. A 100-ampere alternator requires about 2 horsepower from the engine. One horsepower is equal to 746 watts. Watts are calculated by multiplying amperes times volts.

Power in watts = 100 A × 14.5 V = 1,450 W  
hp = 746 W

Therefore, 1,450 watts is about 2 horsepower.  
Allowing about 20% for mechanical and electrical losses adds another 0.4 horsepower. Therefore, when someone asks how much power it takes to produce 100 amperes from an alternator, the answer is 2.4 horsepower.

Many alternators delay the electrical load to prevent the engine from stalling when a heavy electrical load is applied. The voltage regulator or vehicle computer is capable of gradually increasing the output of the alternator over a period of several minutes. Even though 2 horsepower does not sound like much, an sudden demand for 2 horsepower from an idling engine can cause the engine to run rough or stall. The difference in just hundreds of various alternators is often an indicator of the time interval over which the load is applied. Therefore, using the wrong replacement alternator could cause the engine to stall!

PEARSON Advanced Automotive Electricity and Electronics  
James D. Halperin © 2013 Pearson Higher Education, Inc.  
Pearson Education, Inc., Upper Saddle River, NJ 07458

---

---

---

---

---

---

---

---

---

---

11 Charging System

**FREQUENTLY ASKED QUESTION**

**Can I Install an OAP or an OAD to My Alternator?**

Usually, no. An alternator needs to be equipped with the proper shaft to allow the installation of an OAP or OAD. This also means that a conventional pulley often cannot be used to replace a defective overrunning alternator pulley or dampener with a conventional pulley. Check service information for the exact procedure to follow.

PEARSON Advanced Automotive Electricity and Electronics James D. Halperin © 2013 Pearson Higher Education, Inc. Pearson Education, Inc., Upper Saddle River, NJ 07088

---

---

---

---

---

---

---

---

---

---

---

---

11 Charging System

**TECH TIP**

**Always Check the OAP or OAD First**

Overrunning alternator pulleys and overrunning alternator dampeners can fail. The most common factor is the one-way clutch. If it fails, it can freewheel and not power the alternator or it can lock up and not provide the dampening as designed. If the charging system is not working, the OAP or OAD could be the cause, rather than a fault in the alternator itself.

In most cases, the entire alternator assembly will be replaced because each OAP or OAD is unique for each application and both require special tools to remove and replace.

● SEE FIGURE 11-5.

PEARSON Advanced Automotive Electricity and Electronics James D. Halperin © 2013 Pearson Higher Education, Inc. Pearson Education, Inc., Upper Saddle River, NJ 07088

---

---

---

---

---

---

---

---

---

---

---

---

11 Charging System

**FIGURE 11.5** A special tool is needed to remove and install overrunning alternator pulleys or dampeners.

OVERRUNNING ALTERNATOR PULLEY (OAP)

PEARSON Advanced Automotive Electricity and Electronics James D. Halperin © 2013 Pearson Higher Education, Inc. Pearson Education, Inc., Upper Saddle River, NJ 07088

---

---

---

---

---

---

---

---

---

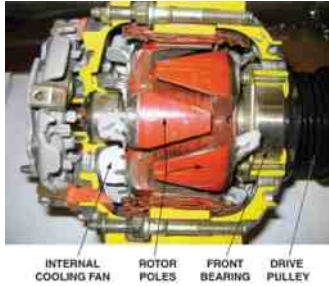
---

---

---

11 Charging System

**FIGURE 11.6** A cutaway of an alternator, showing the rotor and cooling fan that is used to force air through the unit to remove the heat created when it is charging the battery and supplying electrical power for the vehicle.



PEARSON Advanced Automotive Electricity and Electronics James D. Halperin © 2013 Pearson Higher Education, Inc. Pearson Education, Inc., Upper Saddle River, NJ 07458

---

---

---

---

---

---

---

---

---

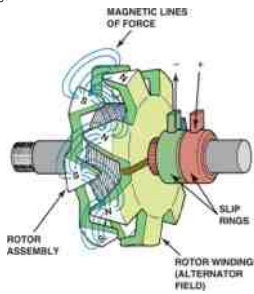
---

---

---

11 Charging System

**FIGURE 11.7** Rotor assembly of a typical alternator. Current through the slip rings causes the "fingers" of the rotor to become alternating north and south magnetic poles. As the rotor revolves, these magnetic lines of force induce a current in the stator windings.



PEARSON Advanced Automotive Electricity and Electronics James D. Halperin © 2013 Pearson Higher Education, Inc. Pearson Education, Inc., Upper Saddle River, NJ 07458

---

---

---

---

---

---

---

---

---

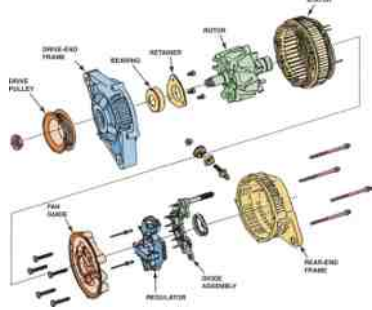
---

---

---

11 Charging System

**FIGURE 11.8** An exploded view of a typical alternator showing all of its internal parts including the stator windings.



PEARSON Advanced Automotive Electricity and Electronics James D. Halperin © 2013 Pearson Higher Education, Inc. Pearson Education, Inc., Upper Saddle River, NJ 07458

---

---

---

---

---

---

---

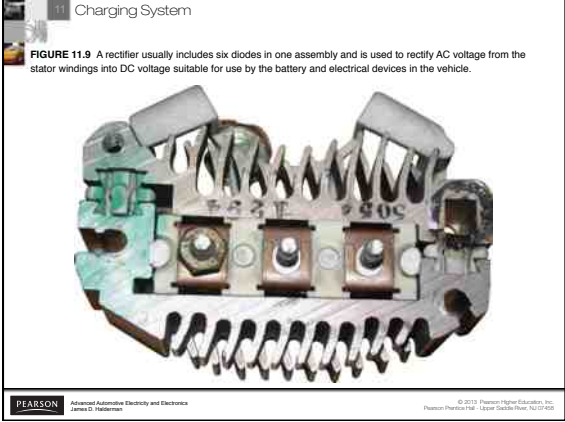
---

---

---

---

---



---

---

---

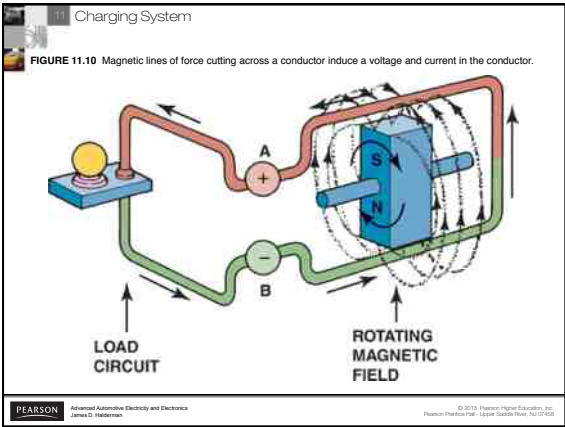
---

---

---

---

---



---

---

---

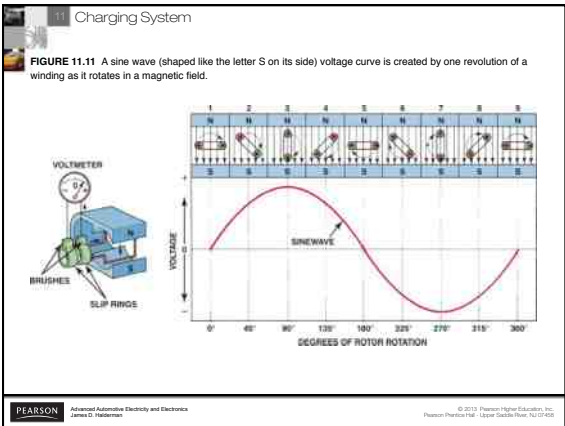
---

---

---

---

---



---

---

---

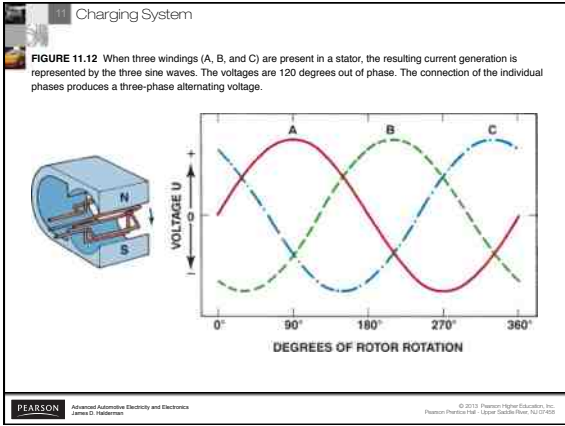
---

---

---

---

---




---

---

---

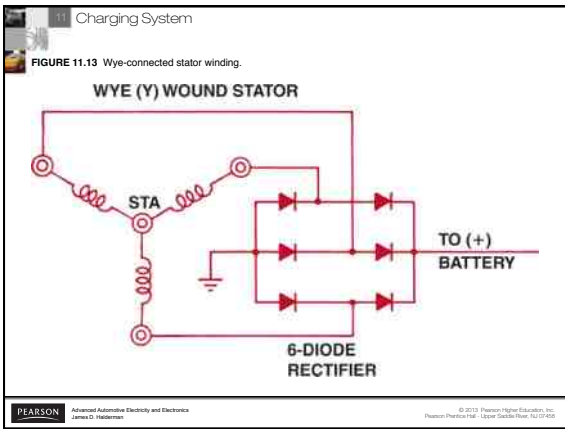
---

---

---

---

---




---

---

---

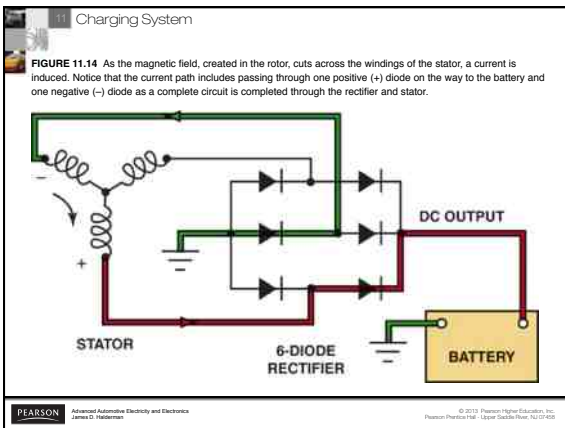
---

---

---

---

---




---

---

---

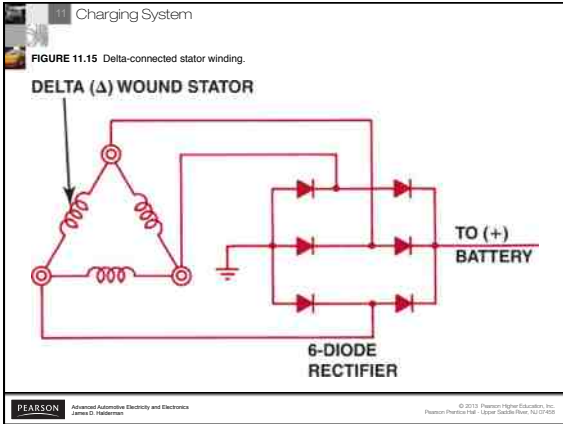
---

---

---

---

---




---

---

---

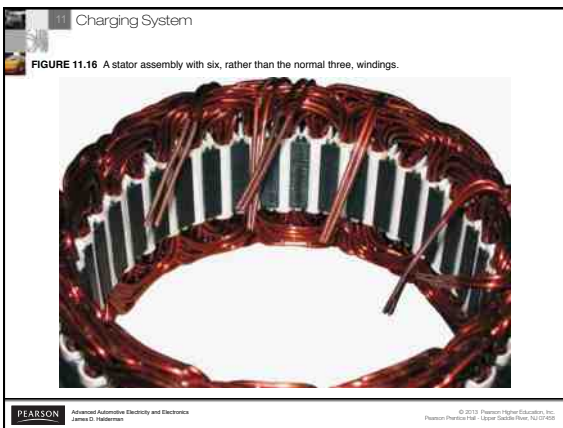
---

---

---

---

---




---

---

---

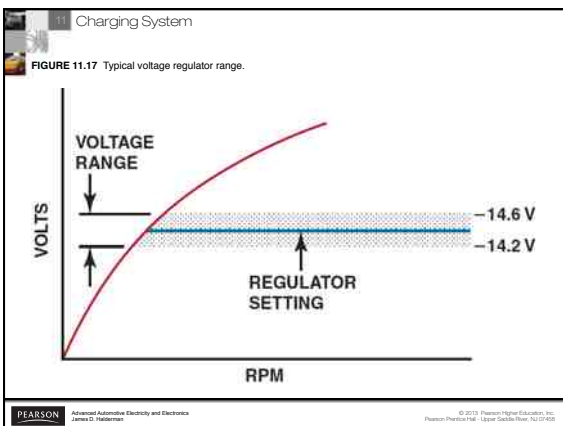
---

---

---

---

---




---

---

---

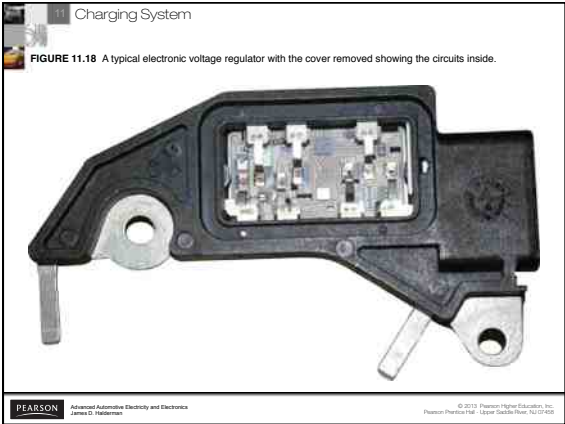
---

---

---

---

---




---

---

---

---

---

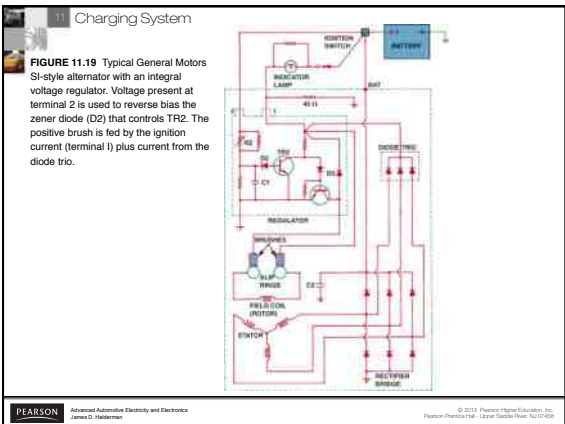
---

---

---

---

---




---

---

---

---

---

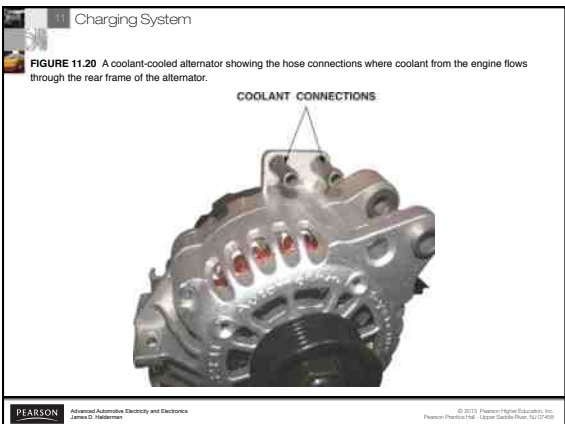
---

---

---

---

---




---

---

---

---

---

---

---

---

---

---



11 Charging System

**NOTE:** Voltmeter test results may vary according to temperature. Charging voltage tested at 32°F (0°C) will be higher than for the same vehicle tested at 80°F (27°C) because of the temperature-compensation factors built into voltage regulators.

PEARSON Advanced Automotive Electricity and Electronics James D. Halperin © 2013 Pearson Higher Education, Inc. Pearson Prentice Hall Upper Saddle River, NJ 07458

---

---

---

---

---

---

---

---

11 Charging System

**FIGURE 11.21** A Hall-effect current sensor attached to the positive battery cable is used as part of the EPM system.

**CURRENT SENSOR**



PEARSON Advanced Automotive Electricity and Electronics James D. Halperin © 2013 Pearson Higher Education, Inc. Pearson Prentice Hall Upper Saddle River, NJ 07458

---

---

---

---

---

---

---

---

11 Charging System

**CHART 11.1** The output voltage is controlled by varying the duty cycle as controlled by the PCM.

COMMAND DUTY CYCLE (%)	ALTERNATOR OUTPUT VOLTAGE (V)
10	11.0
20	11.6
30	12.1
40	12.7
50	13.3
60	13.8
70	14.4
80	14.9
90	15.5

**CHART 11-1**

PEARSON Advanced Automotive Electricity and Electronics James D. Halperin © 2013 Pearson Higher Education, Inc. Pearson Prentice Hall Upper Saddle River, NJ 07458

---

---

---

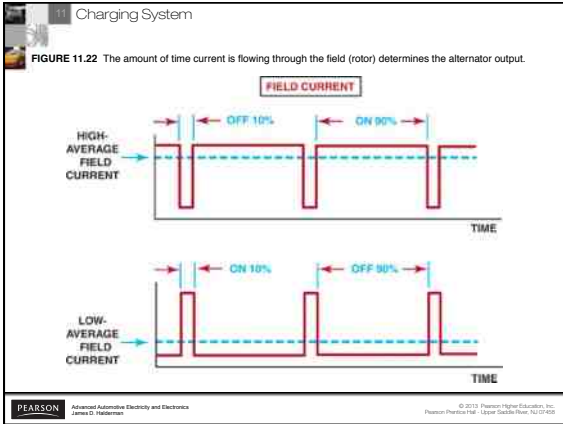
---

---

---

---

---




---

---

---

---

---

---

---

---

11 Charging System

**NOTE:** Some vehicle manufacturers, such as Honda/Acura, use an *electronic load control (ELC)*, which turns on the alternator when decelerating, where the additional load on the engine is simply used to help slow the vehicle. This allows the battery to be charged without placing a load on the engine, helping to increase fuel economy.

PEARSON Advanced Automotive Electricity and Electronics James D. Halperin © 2013 Pearson Higher Education, Inc. Pearson Education, Inc. Upper Saddle River, NJ 07458

---

---

---

---

---

---

---

---

11 Charging System

**TECH TIP**

**The Voltage Display Can Be a Customer Concern**

A customer may complain that the voltmeter reading on the dash fluctuates up and down. This may be normal as the computer-controlled charging system commands various modes of operation based on the operating conditions. Follow the vehicle manufacturer's recommended procedures to verify proper operation.

PEARSON Advanced Automotive Electricity and Electronics James D. Halperin © 2013 Pearson Higher Education, Inc. Pearson Education, Inc. Upper Saddle River, NJ 07458

---

---

---

---

---

---

---

---

11 Charging System

**NOTE: A commanded higher-than-normal idle speed may be the result of the computer compensating for an abnormal electrical load. This higher idle speed could indicate a defective battery or other electrical system faults.**

**PEARSON** Advanced Automotive Electricity and Electronics  
James D. Halperin © 2012 Pearson Higher Education, Inc.  
Pearson Prentice Hall, Upper Saddle River, NJ 07088

---

---

---

---

---

---

---

---