



A battery consists of cells, each capable of chemically producing 2.1 to 2.4 volts. The cells consist of conductive grids coated with lead peroxide (positive plate) or sponge lead (negative plate). The plates are immersed in an electrolyte solution of diluted sulfuric acid. This entire assembly creates a voltage potential at the positive and negative battery posts.

The battery is the link between the starting and charging systems. Any failure of the battery will affect both systems and potentially cause damage. A battery that has one or more bad cells will not accept or hold a charge, causing the charging system to work too hard and damaging the alternator. This same battery will cause excessive amperage draw during cranking, creating heat and damaging the starter. If the vehicle's charging system is not functioning properly, it can cause overcharging, undercharging or deep cycling of the battery. The resulting types of failure are listed below.

### Causes of battery failure:

1. **Overcharging:** If the battery gets too hot, usually because of overcharging, it will cause the positive plates to corrode or warp.
2. **Undercharging:** Continually operating the battery in a partial state-of-charge results in the formation of lead sulfate compounds on the plates. This condition is known as sulfation. This reduces the battery's performance and may cause premature failure.
3. **Excessive vibration:** Vibration can cause material to separate from the grids. It is very important for the battery to be securely fastened in the vehicle.
4. **Excessive "cycling":** A battery is "cycled" when it is discharged and recharged. The process of deeply discharging the battery and then recharging it will damage the plates. Modern "maintenance free" batteries lose 20% of their capacity every time they are deep cycled. This means that after three deep cycles, the average battery will have little more than 50% of its original capacity.

Every late-model vehicle, even when not running, has a small amount of drain from the battery, called "parasitic drain". This drain powers memory in on-board electronic control modules, radios and clocks. It normally will not exceed 30 milliamps, or 0.030 amps. Note that some vehicles can discharge a "budget" battery if parked and not driven for two or three months. When confronted with a discharged battery, it is always best to ask questions like: "How long was it parked?" "Were any lamps or accessories left on?" "Have you checked for parasitic drain?"

To detect a failing battery, a carbon-pile load-bank and an electronic capacitance-tester should be used. The carbon pile will test the battery's ability to deliver cranking amperage. The capacitance test will identify the battery's internal resistance, an indicator of the condition of the plates and the electrolyte solution.

Testing the battery's standing voltage will give you a quick indication of its health. With the engine off, the voltage should be 12.66 for a fully charged battery. If the voltage is any lower, you should recharge the battery, using a battery charger, and then follow the battery test procedures. (See Index)

When testing for parasitic drain, never disconnect the battery. Instead, use an amp meter with an inductive pick-up. Disconnecting the battery to insert a testing device and then reconnecting the battery will cause the vehicle's electronic control module(s) to reset. This will not only clear such things as the radio and clock settings, but may cause the electronic control module(s) to draw many times the normal parasitic drain for a short period of time. In addition, a problem-causing drain can go away when power is removed, and not return until the vehicle is started and shut off again. To avoid misdiagnosis, an accurate amp meter with inductive pick-up must be used for parasitic-drain testing.

## **Testing Safety and Warnings**

- Never disconnect the battery while the engine is running.
- Alternators are designed to maintain batteries, not recharge them from dead.
- Keep hands and test-leads away from belts, fans and other moving parts.
- Be sure belts are not worn and are adjusted properly.
- Start all tests with a fully charged battery.
- Clean and inspect all wires and connections.
- Be sure that all grounding surfaces are cleaned to bare metal.
- Verify that alternator amperage is adequate for the vehicle loads.
- Be sure all mounting fasteners are tight.
- Do not over tighten alternator or battery cable connections.
- Ensure automatic tensioners operate properly. The tension spring should not bind, and the pulley bearing should operate smoothly without excessive free play.
- Ensure the transmission is in park or neutral during all tests, and the parking brake is set.
- Disconnect the battery before removing the starter or alternator.
- When removing the alternator, always disconnect the voltage-regulator plug first and reconnect it last.
- Always disconnect battery negative before battery positive and install in reverse order.
- Never use a battery charger as a power supply to test a starter motor.
- When replacing a starter motor, always inspect the ring gear for worn or damaged teeth.
- Always clean the starter mounting-surface to ensure the starter mounts properly.
- Always ensure all starter or alternator mounting bolts are properly torqued.
- Clean and inspect all connections to the starter, solenoid, alternator and battery when removing and replacing cables.
- Use dielectric gel in all plug connections to avoid future corrosion and water penetration.
- Be sure to replace all original brackets, air ducts, etc to ensure proper support and cooling.
- Some applications require the electronic control module codes to be cleared and reset before a replacement alternator will operate properly. If the proper scan-tool is not available, this will require a trip to either the dealer or a well-equipped electrical shop.
- Always test and charge batteries in a well ventilated area. The gasses emitted by batteries are highly explosive.
- Always wear eye protection when working with a battery, and avoid getting the electrolyte on skin and clothing. The electrolyte is sulfuric acid and is highly corrosive.
- When working with active circuits, be careful to avoid accidentally grounding circuits or contacting wires and terminals with rings, watches or other jewelry. For example, contact from the battery terminal to a wrench and a ring on the hand could cause a short if the ring came into contact with the frame or fender.

### **Special Note**

- The electronic control module may need to be reset using a scan-tool if the “Check Engine” light remains on after any repair.
- Be sure to supply the Vehicle Identification Number (VIN) and Accessory Number before replacing a starter or alternator.