

Subject: Automobile Electrical system Diagnosis & Testing  
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Chapter -4 Alternator and Regulator

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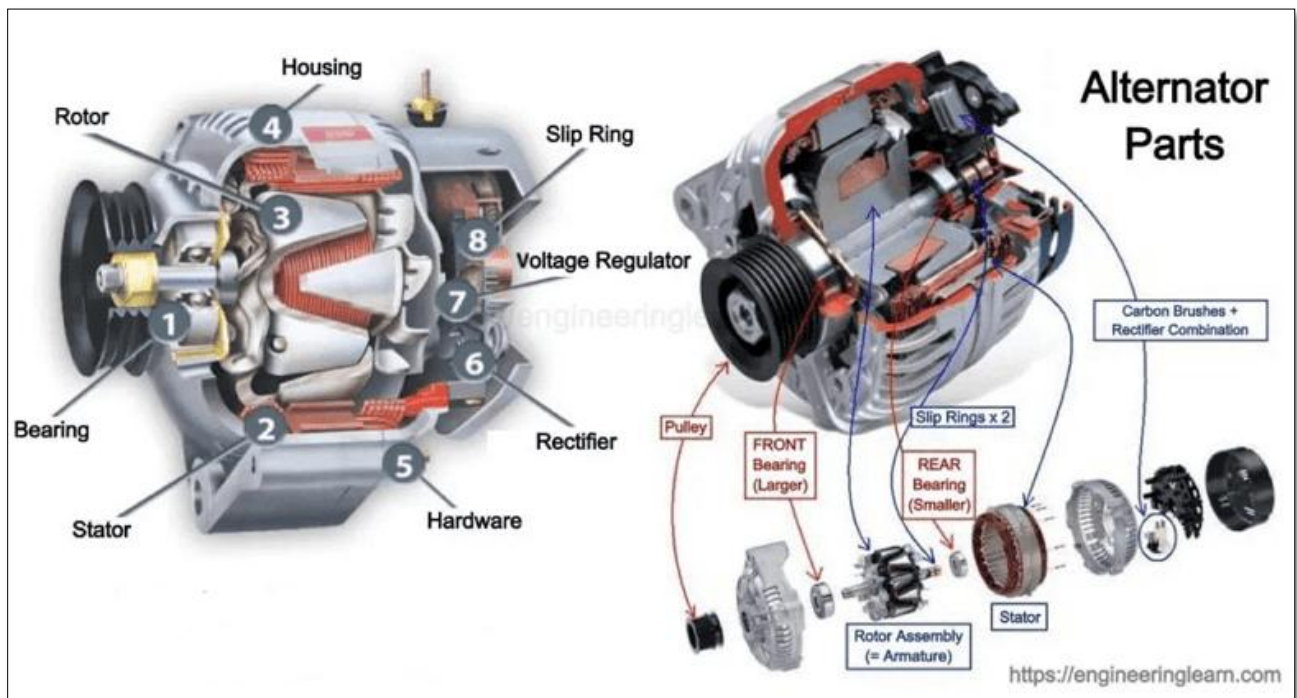
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**Objectives**

After studying this chapter on Alternator and Regulator the reader should be able to:

- 1) Identify various Alternator troubles/Faults and its causes and remedies.
- 2) Diagnose Alternator troubles from symptoms.
- 3) Explain different tests carried out on Alternator.
- 4) Perform periodical checking of the automobile charging system.
- 5) Diagnose Charging System Problems and Potential Causes.



## **Alternator or Charging system Diagnosis and Testing**

**Symptoms of a charging problem are**

1. **Charging system** warning light.
2. Battery Charge low (**Engine Cranks Slowly or Hard starting or Not at All**)
3. **Battery Overcharged (Swollen battery or frequent topping up is required)**
4. Dim headlights,
5. Hard starting or
6. Alternator making noises,
7. Headlights suddenly go dim.

### **Common Symptoms of a Bad Alternator or Charging System**

1. "CHARGE" warning light illuminating on instrument panel while driving or start is the first indication that for some reason, the alternator has stopped charging the battery and your car is running on battery power. If the light illuminates only intermittently, it usually indicates worn-out or bad carbon brushes in the alternator. But remember that the light doesn't always mean there is a bad part; the light may be triggered by a sensor giving a wrong message.
2. When the battery is undercharged, the engine cranks slowly or doesn't crank at all. This may be due to insufficient alternator output or "Unusual Charging System Voltage Drops."
3. An overcharged battery causes the battery to overheat and it requires frequent topping up of battery. If the problem is not taken care of on time, it can ruin your battery.

#### **4. Dimming Lights**

If you notice the headlights, instrument panel, or interior lights dimming, either your battery has a low charge, or there's one or more faulty diodes inside the alternator. Check your battery and check the output of the Alternator.

#### **5. Noises Under the Hood**

Squealing, buzzing or grinding noises coming from the engine may be caused by bad alternator components, a loose or worn-out serpentine belt, or a faulty belt tensioner.

### **Charging System Tests**

These series of charging system checks help diagnose the general condition of charging system. and locate the source of the problem.

#### **1. Make a Visual Inspection of the System**

With the engine off, visually inspect the different components of the charging system. Look for a worn out or loose drive belt, alternator connection problems, loose alternator mounting bolts, and corrosion and dirt around the battery case and cables.

When inspecting the drive belt, check for adjustment. If necessary, adjust the belt with the help of your car owner's manual or repair manual. Inspect the belt for signs of cracks, cuts, shiny spots, deterioration or other signs of wear or damage. Change the belt and belt tensioner at the manufacturer's recommended interval.

## **2. Check for Wiring Problems**

Inspect the wires and connections at the back of the alternator, at the remote voltage regulator (if applicable), and at the battery. Look for corrosion at the connectors, damaged wires, and burned and missing insulation that might suggest an electrical short.

## **3. Do This If the Indicator Light Stays On, or Goes On and Off**

Follow the next steps:

- Start the engine and apply the emergency brakes. Set the transmission to Neutral (manual) or Park (automatic).
- Connect a voltmeter across the battery terminals.
- While watching the voltmeter display, start wiggling wires at the back of the alternator, the battery..
- If the voltage reading on the meter display goes up while wiggling one of the wires, found has a bad electrical wire or connection.

Instead of using a voltmeter, you can have an assistant watch the indicator light on the instrument panel to see if it turns off as you wiggle various wires and connectors. Once the light turns off, you've found the problem connector or wire.

## **4. Check for Alternator Noises**

Bad alternator bearings, rectifiers, rotor shaft, stator winding, slip rings, brushes and other parts inside the alternator with mechanical or electrical problems can become noisy.

Here's a test you can do: Use a length of vacuum hose to listen for alternator noises. The hose will amplify the noise if it's coming from the alternator. But be very careful around moving parts while you do this test.

- Start the engine.
- Place one end of the hose against your ear and move the other end around different points of the alternator body.
- Listen for whining noises (this can indicate a bad diode or an over-charging condition), grinding (bad bearing), squealing, or other abnormal noise. If necessary, have your alternator checked.

## **5. Check for Under-Charging and Over-Charging**

The next three tests are best done using a load tester, but you still can use your digital voltmeter. You do this by measuring system voltage while loading the system.

**5a.** First, measure battery base voltage to make sure you have a fully charged battery.

- Turn on the high beams for 10 seconds and then turn them off.
- Wait for two minutes
- Measure battery voltage across the battery posts with your DMM. You should get between 12.4 and 12.6V. This means your battery is fully charged. If you get a reading below 12.4V, charge the battery before continuing.

**5b.** Measure the Charging System's No-Load Voltage

- Ask an assistant to start the engine and hold engine speed at about 1500 RPM.
- Measure voltage across the battery with your DMM. You should get 0.5 to 2 volts higher than base voltage. If you are getting more than 2 volts above base voltage, most likely your alternator is over-charging the battery or the battery is faulty. Other potential problems are a faulty voltage regulator or a problem in the charging system wiring. As part of your wiring checks, see the section "Troubleshooting for Unusual Charging System Voltage Drops" below.

**5c.** Measure charging system load voltage with a high-current-condition system measurement.

- Ask an assistant to start the engine and hold engine speed at about 2000 RPM. Turn on all electrical accessories like A/C, blower motor, headlights, defroster, wipers. But don't turn on the heated windshield if your vehicle has one; alternator voltage may increase to over 100V and this can be unsafe.
- Take a voltage reading across the battery posts. Your reading should be at least 0.5 volts above base voltage for your system to keep up with electrical system demands. Otherwise, the charging system can't meet the demand and charge your battery. This fault could point to a faulty alternator or voltage regulator.

## **6. Check for Alternator AC Voltage Leak**

Alternators use diodes to rectify alternating current produced by the alternator into direct current. When one or more diodes go bad, the alternator can cause all kinds of problems. AC voltage leak can cause your lights to dim and drain power from your battery, for example. Usually, you can detect this leak by measuring AC voltage across the battery posts using a digital multimeter.

- Start and let the engine idle.
- Set the parking brake and your transmission to Park (automatic) or Neutral (manual).
- Set your meter to a low AC voltage range and take your measurement.
- If you detect even a small amount of AC voltage, replace the alternator.

Once you've determined the condition of the system, you can go over the next section to zero in on the potential problem(s) that may be causing the condition of the charging system.

## **Charging System Problems and Potential Causes**

## **1. If the Battery Seems to Stay Undercharged**

**a)** Check the drive belt or serpentine belt, especially if you haven't replaced it in the last five years. Make sure the belt has the proper tension. Look for signs of wear or damage like cuts, shiny spots, missing chunks. Today serpentine belts don't show signs of wear, even if they need to be replaced. Use a belt wear indicator or check your maintenance schedule for the replacement interval suggested by your car manufacturer. You may find the schedule in your car owner's manual or your repair manual.

**b)** Along with the drive belt, check the belt tensioner as well. Make sure it turns freely and is noise-free. Car manufacturers recommend replacing the tensioner at the same time you replace the drive belt.

**c)** Make sure your battery connections are tight and clean. However, just because the terminals look clean, it doesn't mean they are tight and in good condition. Look for damage to the cable and the terminal itself that may prevent proper electrical current flow.

**d)** Check your battery yourself, or take it to your local auto parts store. Many of these stores will test your battery for free.

**e)** There's a parasitic battery drain stealing power from your battery.

- A quick test is to connect a test light in series between the positive battery cable and the positive battery post. If the test light comes on, there is an electrical drain in one of the systems.
- First, unplug the alternator electrical connector. If the test light goes out, the alternator is causing the drain. If not, locate the parasitic drain.

**f)** Don't overlook the starter motor: a failing starter motor may draw excessive current during operation, draining battery power. If necessary, have your starter motor or starting system tested.

## **2. If the System Seems to Be Over-Charging**

Besides test results, another potential sign that your battery is being overcharged is that your battery terminals keep accumulating corrosion.

### **Here are some checks you want to do:**

- Make sure that all the connections to the alternator are clean, tight and in good condition.
- Check for a bad alternator voltage regulator and circuit.
- Make sure you have good ground connections at the alternator (alternator case) and voltage regulator. Grounds should be free of rust, and the alternator and remote voltage regulator mounting bolts should be clean and tight.
- Check the alternator rectifier or have your alternator checked at the auto parts store.
- Also, conduct the tests described in the Troubleshooting for Unusual Charging System Voltage Drops below.

## **3. If the Alternator Is Not Charging the Battery**

When your tests point to an under-charge or no-charging condition:

- Make sure the drive belt is not loose or worn out.
- Manually check the belt tensioner for proper operation. Make sure the tensioner pulley turns freely and without noise. Check it for damage.
- Manually turn the alternator pulley and make sure it turns without a problem. If one of the bearings has seized, it won't allow the alternator to turn freely.
- Check that the connections at the battery, alternator, and remote voltage regulator are clean and tight.
- Check for a blown fuse or fusible link. Consult your vehicle repair manual, if necessary, to locate the alternator fuse or fusible link.

#### **4. If the Engine Makes Noises**

Noise can be a sign of alternator problems when it comes from the charging system. The next checkpoints will help you isolate the source of the noise.

- Check the drive belt or serpentine belt. Look for signs of wear or damage like cuts, shiny spots or missing chunks under the belt. A worn out belt can squeal during operation.
- Also, check the belt tensioner for proper operation and damage. It should rotate freely.
- Make sure the alternator is properly mounted. Loose mounting bolts can cause the alternator drive belt and drive pulley to become misaligned and noisy.
- Check the alternator for noises. See the General Charging System Checks section for a simple procedure for this.

#### **5. If Lights Dim During Engine Operation**

Most alternators use diodes inside a rectifier to turn Alternating Current (AC) into Direct Current (DC) for use by the system. When one or more diodes go bad, AC can leak into the electrical system. Sometimes you can notice this when the headlights, instrument panel lights, and other interior lights dim during engine operation. To test your alternator for AC current leaks, see the Alternator AC Voltage Leak Check subsection in the previous section.

#### **Troubleshooting for Unusual Charging System Voltage Drops**

A charging system voltage drop check can help you locate the source of an under-charge or over-charge condition due to problems in the wiring or connections between the battery and alternator.

- 1.** Start the engine and let it idle. Apply the parking brake and set the transmission to Neutral (manual transmission) or Park (automatic transmission).
- 2.** Turn on the high beams, AC, wipers, and other accessories to provide a system load. Have an assistant raise engine speed to about 1500 RPM. But if your vehicle is equipped with a heated windshield, don't turn it on; this can make alternator voltage go over 100 V. Since you'll be working around alternator connections, this could be dangerous.
- 3.** With your voltmeter test leads, touch the positive battery post and the B+ terminal connector at the back of the alternator.

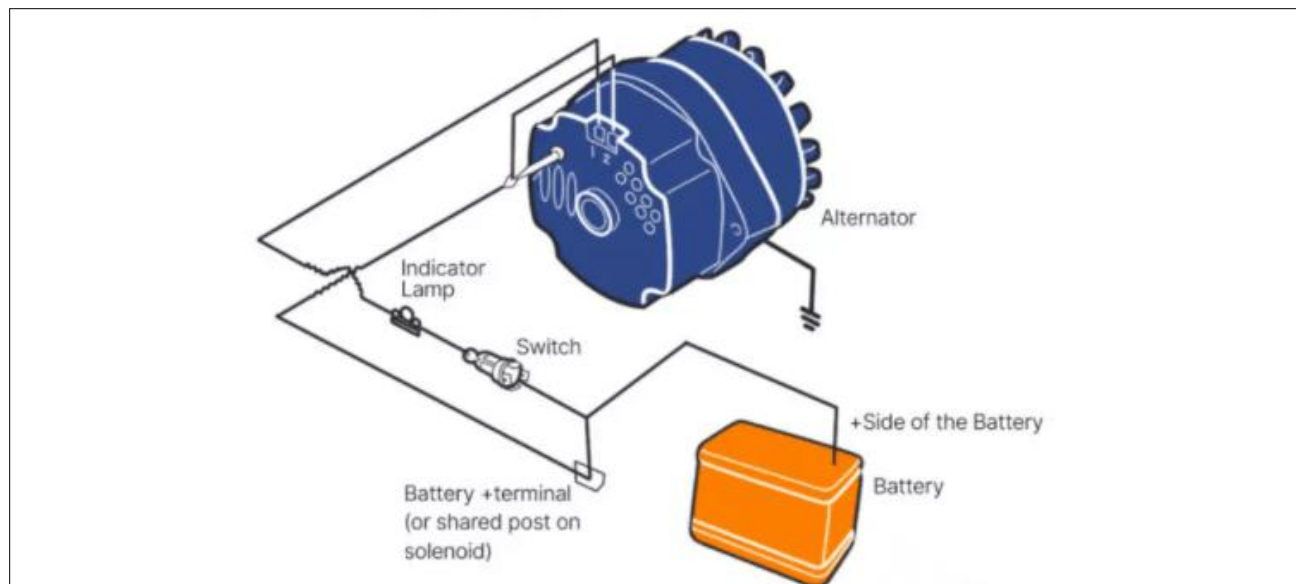
4. Check your meter display. You should get around 0.2V or less of voltage drop. Getting 0.3V or more can lead to an under-charge condition. Check the connections in that part of the circuit for a loose wire, corrosion at the connectors or wiring damage that may prevent proper current flow between the battery and alternator. Also, check the electrical connections at the back of the alternator and at the voltage regulator.

5. Now repeat the test, but this time, connect your meter leads between the battery negative post and the alternator case.

6. Check your meter display. Again, you should get a voltage reading around 0.05V. If you get 0.1V or more, there's something wrong. This can lead to an over-charging condition. Checking that part of the circuit, make sure the battery ground connection is good, clean and tight. Add a temporary ground connection from the battery to the chassis. If this removes the high voltage drop, check the engine to body grounds connections. They should be clean, tight and in good condition.

**A typical alternator may last anywhere from 8 to 12 years.**

Wiring connections of a typical alternator.



This is a three-wire alternating wiring diagram showing the connections between the different components of a circuit. The circuit comprises three main wires: battery positive cable, voltage sensing wire, and ignition wire. The ignition input wire is attached to the engine. It conducts electricity from the engine to the alternator while the voltage detecting cable senses the voltage and is attached to the rectifier.