

What Destroys Voltage Regulators and Diodes?

When alternators stop working correctly, two of the most common causes are (electronically) damaged diodes or voltage regulators. However, a misperception exists that most of these failures result from “poor quality or workmanship.” In reality, the vast majority of damaged diodes and regulators result from the harsh under-hood environment and interaction with other charging system components (battery, wiring, connections, etc.).

The current generated by an alternator is known as alternating current (AC), while direct current (DC) is required to charge a vehicle’s battery. Diodes are located on a component called the rectifier. Thus, the diodes “rectify” or transform the AC output into DC output. Basically, diodes serve the same function as one-way check valves in a hydraulic system. In addition, preventing AC from exiting the alternator is crucial to protecting sensitive vehicle electronics.

The voltage regulator controls the voltage produced by the alternator in order to maintain the proper battery state of charge. If battery voltage falls below a pre-set threshold, the regulator allows the alternator to “turn on” and charge. This “on-off” switching may occur many times per second (similar to how the vehicle’s computer controls fuel injector pulses). The longer the alternator is pulsed “on”, the more amperage it will produce.

As solid state devices, diodes and regulators are normally extremely reliable. However, both components operate in a brutal, high under-hood heat environment. Coupled with alternator size/weight restrictions, these components must perform near their maximum heat tolerances.

What pushes diodes and regulators past their design limits?

- 1) Prolonged Maximum Charging Output – Except for brief periods, alternators should not operate at more than 75% of rated output. Do not use an alternator as a substitute battery charger or add special accessories (large stereo, etc.) without seeking a higher amp alternator.
- 2) Corroded Wiring – Corrosion increases resistance and causes alternators to run abnormally hot. Clean all alternator output wire connections, and check for excessive voltage drop.
- 3) Older Batteries – As batteries age, they also corrode internally, developing increased resistance and reduced storage capacity, thus overheating and/or overworking the alternator. Even “good” batteries over 3 years old should be tested and considered for replacement.
- 4) Abnormal Voltage Spikes – The battery and other surge suppression devices absorb routine system voltage spikes. However, millisecond spikes well over 100 volts may result from improper alternator/battery hookup or disconnection.

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What Destroys Voltage Regulators and Diodes? (continued)

Never momentarily disconnect the positive battery cable, and always follow recommended jump starting hookup sequences.

Lastly, when a battery begins deteriorating, it may still crank the engine every day. As a result, the battery is often overlooked as the source of “an alternator problem.” Using a battery conductance tester helps identify certain faults that do not register on a carbon-pile load test.

Knowing the above potential causes of premature diode or regulator failure should help increase alternator life considerably and reduce warranty replacements.



Regulator



Rectifier

