# HOW TO DIAGNOSE AND CURE A CLICKING STARTER

By Paul Weissler

You twist the ignition key to start your engine, and instead of the syncopated whirling of a cranking starter and crankshaft, you hear a click or a series of chatter like clicks. The engine that started every day for so long is not going to start today. Time to hitch a ride to work. If it's a weekend, you get the chance to find out why your vehicle has died and fix the problem before Monday morning.

That clicking noise is from either the starter solenoid or the relay. The solenoid is part of the starter. Typically it has a terminal for a thick power feed wire from the battery, and a thinner terminal for the current supply wire to a switching mechanism in the solenoid.

The relay is a remotely mounted switching device between starter and battery that controls either the thick power feed or the thinner electrical feed to the solenoid's switch terminal.

The first step (although at this point it doesn't tell you the root cause) is to find out where the click is coming from. If you have a helper turn the ignition key to start, you'll be able to trace the underhood click. If it comes from the starter, your problem is in the solenoid. Ford and Chrysler products usually have a relay in the circuit. If the solenoid isn't the source of the click, tracing the sound should take you to the relay on those models.

Even after you know what part is clicking, begin your real diagnosis at the battery. If the battery top has an "eye" indicator (actually a battery hydrometer that indicates the state of charge), recharge if the indicator is black. If it's green, it's got a normal charge. If it's yellow, get a new battery because the electrolyte is too low.

There's no indicator eye? Connect a voltmeter across the battery terminals (positive lead to positive terminal, negative lead to negative terminal).

> If the meter reads under 12.4 to 12.5 volts, it's borderline or undercharged (depending on the design of the battery). Recharge it for the day. Batteries do run down as a result of a temporary series of operating conditions (lots of short trips, for example), but if the problem recurs, you'll have to check charging system output and the possibility of a short circuit.
>
> If the reading is 12.7 to 12.9 volts, that's a good starting point. After a recharge, operate the headlamps for 15 seconds to remove what is called the "surface charge." The meter reading should not drop more than about 0.2 volt.
>
> The reading is okay? Have a helper turn the ignition key to start, and in 15 seconds, read the meter.
>
> If it's below 9.5 volts, the battery may not be strong enough. Professionals have battery load testers to make sure. Your alternative: If the battery voltage was normal when you started, but is low during the attempt to crank, try a jumpstart. If the engine cranks normally with a boost, the battery probably is bad.

Loose or corroded starter cables can cause enough voltage drop to cause a clicking, intermittent connection. Clean with a wire brush and then rinse with warm water. Check for voltage drop between battery post and starter terminal while a helper cranks the engine. Up to 0.50 volt is acceptable.

**Corroded, Distorted Terminals:** If the engine still won't crank, next inspect the cables and their connections at both ends. If you see corrosion or a possibly poor connection, make a voltage drop test.

First, connect the voltmeter negative lead to the battery ground terminal and the positive lead to the engine block, close to the starter. With the key held in the start position, the voltmeter should read under 0.5 volt.

If the voltmeter reading is 0.5 volt or higher the drop is excessive. In fact, if it's above 0.2 volt, that's really too high and could be a contributor to the problem if the battery is marginal.

Perform the same check with the power feed side of the circuit (in this case, connect the voltmeter's positive lead to the battery, and the negative lead to the starter's battery cable terminal). Get a high reading?

Repeat the test, taking special care to make contact at the battery post or side-terminal bolt, not the cable end.

If the voltage drop now is within reason, the cable terminals are the problem. A simple cleaning may be all that's necessary, but if a cable's post terminal is distorted, the jaws may be tight even though the inside surface is not making good contact.

If the cable end is distorted or corroded, replace it. Get a quality cable end, which includes a section of cable with a protective sheath, not just a terminal. Cut the corroded cable back to where the copper wire is absolutely free of any corrosion. Install the new cable end and join it to the remaining cable (some repair cable sections have heat-shrink insulation, and others have screw retainers or crimp on).

No sign of corrosion on a ground cable? Remove the grounding bolt at the engine, clean the cable end and bolt, reinstall and tighten.

**Checking The Starter Terminals:** At the starter, inspect the terminals for both the battery (thicker wire) and solenoid switch for corrosion and physical damage. If the corrosion is minor, you may be able to remove the retaining nut and battery cable and wire-brush corrosion away. If the corrosion is so severe that cleaning it off leaves the threads damaged, install a repair stud, which cuts new threads onto the damaged studs.

Now try to crank the engine. No improvement? With good connections at both ends (battery, ground and starter), try direct wiring with jumper cables.

Don't Have A Good Meter? If you don't have an accurate voltmeter, you still can eyeball and make hands-on inspections for tightness of the cable connections at both ends. Clean and tighten the cables and see if the engine will crank.

Still no success?

Disconnect both battery cables and make direct connections with booster cables, one from the battery's negative post to engine ground, one from the battery positive terminal to the starter solenoid terminal. Do a follow-up test with the booster to the starter battery terminal, plus a jumper to the solenoid terminal. These test procedures can be physically difficult to perform on many vehicles, particularly those with a side terminal battery, but they usually can be done. Just take the time to make good connections with the jumpers.

If you can get the engine to crank this way, the problem obviously is in the cable connection. If a Ford or Chrysler product's relay is the source of the click, it may not be operating properly. If running jumpers to the solenoid or starter (bypassing the relay) gets the engine to crank, test the relay.

On Ford products, connect a booster cable across the thick-wire terminals of the relay, and if the engine now cranks, replace the relay.

On Chrysler vehicles, find the power feed (it's the wire terminal that turns on a grounded 12-volt test light). Connect a jumper wire from that terminal to the one for the power output wire (usually red) that goes to the starter solenoid.

Needless to say, be sure the vehicle is out of gear and the wheels are blocked before making any attempt to turn the engine over.

On models with plug-in relays, you may have trouble finding the color codes, but the wiring diagram should indicate the power feed and output terminals and their numbers, which you'll find on the relay itself. Turn on the ignition. You now can use a grounded test light to find the power feed terminal, but you'll have to eyeball the relay's terminal numbers to figure out which is the output wire terminal (to the solenoid) in the underhood center itself. Connect a jumper from the power feed to the output, and if the engine cranks, replace the relay.

Make cleaning and tightening all the connections a spring and fall ritual and your engine will make reliable cranking a year-round habit.

Be sure the ground wire to the body as well as to the engine block is good. Replace corroded wires and tighten fasteners. Over tightening cast battery terminals can leave them loose. Use a self-tapping repair stud rather than replacing the whole starter if the terminal threads are damaged or stripped.

**HOW IT WORKS**:

**Starter Solenoids** - A solenoid is an electromagnetic device that is capable of doing work, and in some starters, it does two jobs.

1) It moves a plunger that makes electrical contact between terminals for the battery and the starter motor, so the motor turns. If that's all it does, it's really just a switching device.
2) In some starters, the movement of the plunger also pushes a linkage that moves the starter's drive gear into mesh with the flywheel ring gear.

The solenoid has two wire coils. One is large, draws a lot of current and produces a strong magnetic field. That's enough to move the plunger. Once the plunger is in position (having completed the circuit and moved the starter drive), the large coil is disconnected and the circuit for a small coil is completed. The small coil draws a small amount of current and produces a weaker magnetic field-just enough to hold the coil in position. This saves battery energy for the big job of cranking the engine. If there isn't quite enough battery electrical pressure (voltage) to provide the current flow, however, the plunger won't lock into position so the small coil can take over. If this happens, all you hear is a solenoid click, and the plunger springs back. Some solenoids have an extra small-gauge terminal. This bypasses the ballast resistor, ensuring a hot spark while cranking.