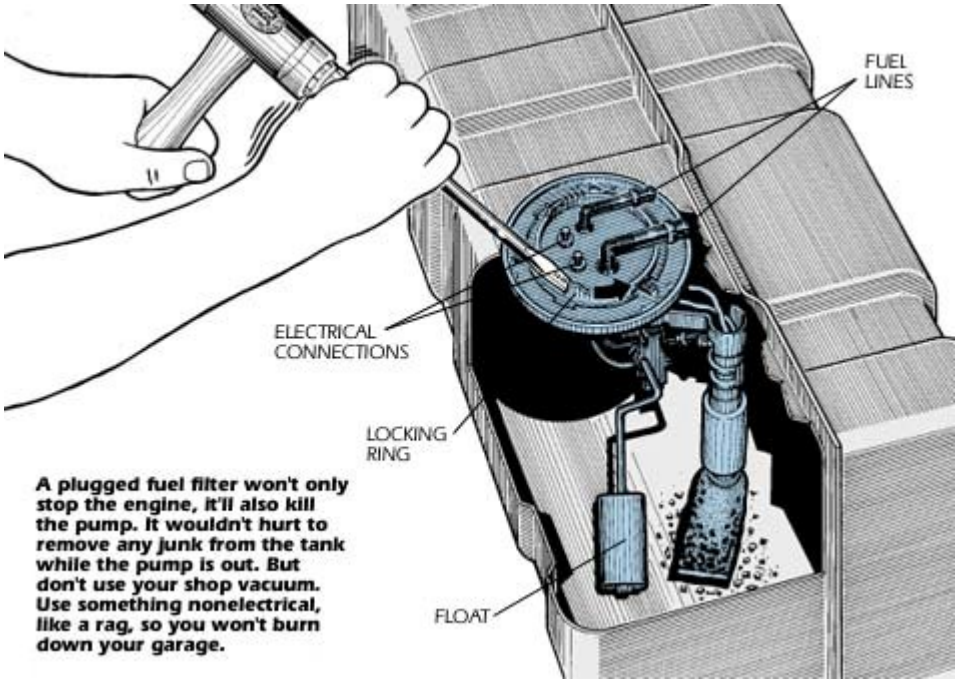
Replacing your fuel pump

Ten minutes late. Gulp half your coffee, sprint out to the car. Twist the key and she cranks. And cranks. And cranks. No fire, and your ulcer potential increases along with your blood pressure. It always seems to happen when you're behind schedule, as if the gods of internal combustion are eternally against you. You should've paid attention to that occasional bucking on the highway.

If there's anything over 60,000 miles on the odometer, but more commonly 100,000 plus, there's a good chance that the cause of this distressing no-start condition is an electric fuel pump that's no longer capable of forcing fuel forward with sufficient pressure. Even if the condition hasn't reached the point of grounding you, pump inadequacies can cause numerous drivability problems, such as momentary cutting out, hesitation, low power and stalling at inopportune moments (typically, it'll start again after it's cooled off).

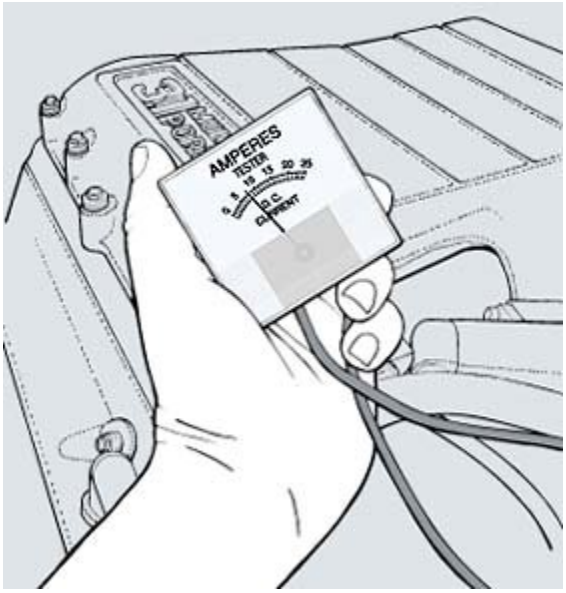
For years, the car companies have been looking for a pump life of 10,000 hours (say, 400K miles) as a bogey. Now, they're asking their O.E. suppliers for "life-of-car" (that many miles isn't a car's life span anymore?). To reach this goal, pump makers have lowered amperage draw and balanced armatures more precisely. That's all very admirable, but ask any service technician and he'll tell you that they simply don't last anywhere near that long in most cases. What's happening?

In a word, crud. Many (most?) of the fuel filters replaced are so jammed up you can't blow through them. If you had checked the pump's amperage draw before removing the old filter, you might have seen up to twice the expected number–perhaps eight to 10 instead of four to six. It shouldn't take much of an intellectual leap to realize that a plugged fuel filter will make a pump work harder, and all that extra current will wipe out the brushes and groove the commutator, killing the pump prematurely. Also, the pump's already digested whatever's causing the restriction. While on the subject of pump fatalities, another reason pumps burn out is because immersion in gasoline is necessary for cooling, yet people run around on "E." So, try to keep your tank at least half full.



A plugged fuel filter won't only stop the engine, it'll also kill the pump. It wouldn't hurt to remove any junk from the tank while the pump is out. But don't use your shop vacuum. Use something nonelectrical, like a rag, so you won't burn down your garage.

Two-Legged Tripod?

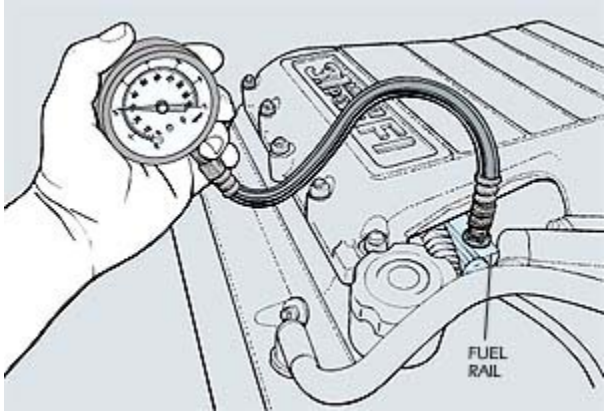


Find out how many amps the pump is drawing with a current draw test. Just bypass the wiring and run jumpers from the battery.

For a century, mechanics have been taught that spark, compression and fuel are the legs of the tripod that support an engine's ability to run, and that's still true. So, before you jump to any unfortunate conclusions about your fuel pump, do a spark check (a story for another day) and make sure the camshaft is still connected to the crankshaft (remove the oil filler cap and watch the cam or rockers while you have a helper crank the engine). If these two essentials are okay, you can start thinking gasoline. Turn the key on and listen carefully. In most cars, you'll hear the pump run for a few seconds. No? Then check the fuse. If it's blown, and the car starts after you replace it, you should still find out how many amps it's being forced to carry. If pump electrical draw is too high, a fix now will head off a future breakdown. You'll need either a low-reading analog ammeter or a DMM (Digital Multi-Meter) with sufficient current-carrying capacity. Amperage testing is done either by hooking up the meter in series with the load, or with an inductive pickup that you clamp around the wire. The latter works best with big current flow, such as you'd find in the starter circuit, so we prefer the former for diagnosing fuel pumps. That means you've got to break into the circuit. Connect one of the ammeter's leads to the positive battery post and the other to the pump's hot wire. Look this up in a service manual or via your PM CD-ROM. Ditto for the specs, but we will say that if you see anything over 5 amps with a low- to mid-pressure system (13 to 45 psi), or 7 amps with a high-pressure version (60 psi) you've got a problem. Will on-board diagnostics help you here? Not very often, although a problem in the pump relay circuit will set trouble code No. 42 on a typical Chrysler product, or code No. 87 on a garden-variety Ford.

Excluder And PSI

Have you replaced the fuel filter at the recommended intervals? How about ever? If you've been lax in this regard, it's certainly one of the first things to check. Even if it's not the reason the engine won't fire up, it's critical maintenance that you should be doing anyway, so you're not wasting your time.



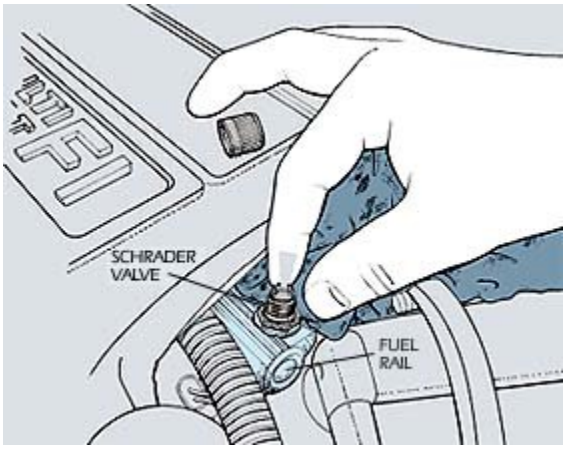
A fuel pressure gauge can tell you plenty. Take readings dead-head (key on, engine off) and running.

Important: Filter removal will be a lot less dangerous and messy if you relieve system pressure first. Wrap a rag around the Schrader valve on the fuel rail and press down on the valve's pin. Or, remove the fuel pump fuse, and crank for 20 seconds. Checking fuel pressure is one of the basics of troubleshooting, and reasonably priced gauges are available. Most screw onto the Schrader, but with some imports such as Toyota, you'll need a special banjo connector. Turn the ignition on and read the gauge. No or low pressure may mean the pump's electrical circuit is faulty. This could be because of a defective control relay, but check for bad connections before you think about a new relay. Examine all the connectors for evidence of corrosion or looseness. Test for the presence of battery voltage at the pump's positive terminal or wire, and check for a bad ground as well. By the way, an inertia-type safety switch in the pump's circuit, as found on many Fords, can be tripped by a minor impact, such as bumping into a snowbank.

Voltage-drop testing is the best way to locate high resistance. With the circuit powered up, use an accurate voltmeter to see if you get a reading across connections and lengths of wire. Anything more than about 0.2 volt is too much. Other possible causes of too few psi to start the car are the already-mentioned clogged filter, a pick-up sock in the tank that's blocked, a crimped line or, of course, a weak pump. If key-on/engine-off pressure was within specs, use a test light at the appropriate injector wire (or, pull an injector connector and plug one of those inexpensive "noid" lights into the harness). No flashing? Then the injectors aren't firing, which means troubleshooting will have to graduate to a whole other level of complexity as you look into the electronic engine management and EFI systems.

It Starts, But …

In cases where the engine runs, but has a driveability problem, concentrate on your gauge readings. You should see violent needle swings between dead-head and running pressures. A slow rise means trouble. Pull the pressure regulator's vacuum hose and you should see an increase. Too many psi may be due to a defective regulator or a restricted return line. Just because you've got specified pressure doesn't mean there's sufficient flow. Total system volume at the Schrader of 1 pint in 20 seconds will run any car. (While a typical pump may flow 30 gal. per hour, less than a tenth of that is needed to run the engine. The rest is returned to the tank, which helps keep everything cool.)

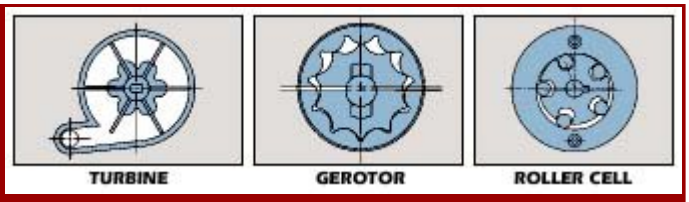


Before you open any connections, relieve system pressure.

Kaput

Pump replacement may be easy or difficult, depending on the design. On vehicles with in-tank pumps, access is sometimes just a matter of folding back the trunk mat and removing a panel. Others require that you drop the tank, which can be quite a ponderous undertaking, especially if you've just filled up (gasoline weighs 6 pounds per gallon). We use the term "drop" in a mechanic's sense here–we don't really mean to drop it. You can siphon it down–dump what you get into your other car, or give it to a neighbor. If you have a good floor jack, put a big square of plywood between it and the tank. Remember that there's still a certain amount of fuel in the tank after you've drained it. No smoking, and dry up any spilled fuel right away. It'd be a really good idea to work outdoors, too. Remember that gasoline vapor is heavier than air, and will spill down the basement stairs until it finds the pilot light for the water heater. *Poof!* Speaking of flammable, don't even think about working on an electric fuel pump until you've disconnected the negative battery cable. Once you've got access, the actual removal and installation is pretty straightforward. Special spanners are often recommended for unscrewing the pump assembly locking ring, but we'll bet you'll figure something out. Just make sure you get that sock or strainer on there right.

HOW IT WORKS: Fuel Pumps



Unlike mechanical fuel pumps, which are necessarily attached to the engine, the electric variety is mounted back in or by the tank. There are three types: roller cell, gerotor and turbine. The first uses rollers in a notched rotor to catch gasoline and force it into a small-volume area of the housing. It has lots of moving parts and can be noisy. Gerotors are similar to some oil pumps–they squeeze liquid by means of the eccentric action between a star-shaped rotor and a matching element that surrounds it. Today, however, the O.E. trend is toward the turbine type.

With throttle-body fuel injection (also called "wet throttle plate"), electric pumps typically put out 15 to 20 psi, whereas port injection requires 45 to 60 psi.

If you're still wondering why mechanical pumps aren't used with fuel-injected engines, think pressure and volume. The former has to be higher than the 3 to 5 psi a typical mechanical unit supplies. Otherwise, you won't get that nicely vaporized plume that burns so well. Plenty of fuel has to be flowing all the time, too. Only a small percentage of what's available is actually used even at full throttle. The rest serves to keep those injectors and rails cool as it recirculates to the tank. That, plus the location of the pump way back in or by the tank, pretty much eliminates vapor lock problems.