TECHNICAL TRAINING SERIES

UNDERHOOD SERVICE

Fuel Delivery

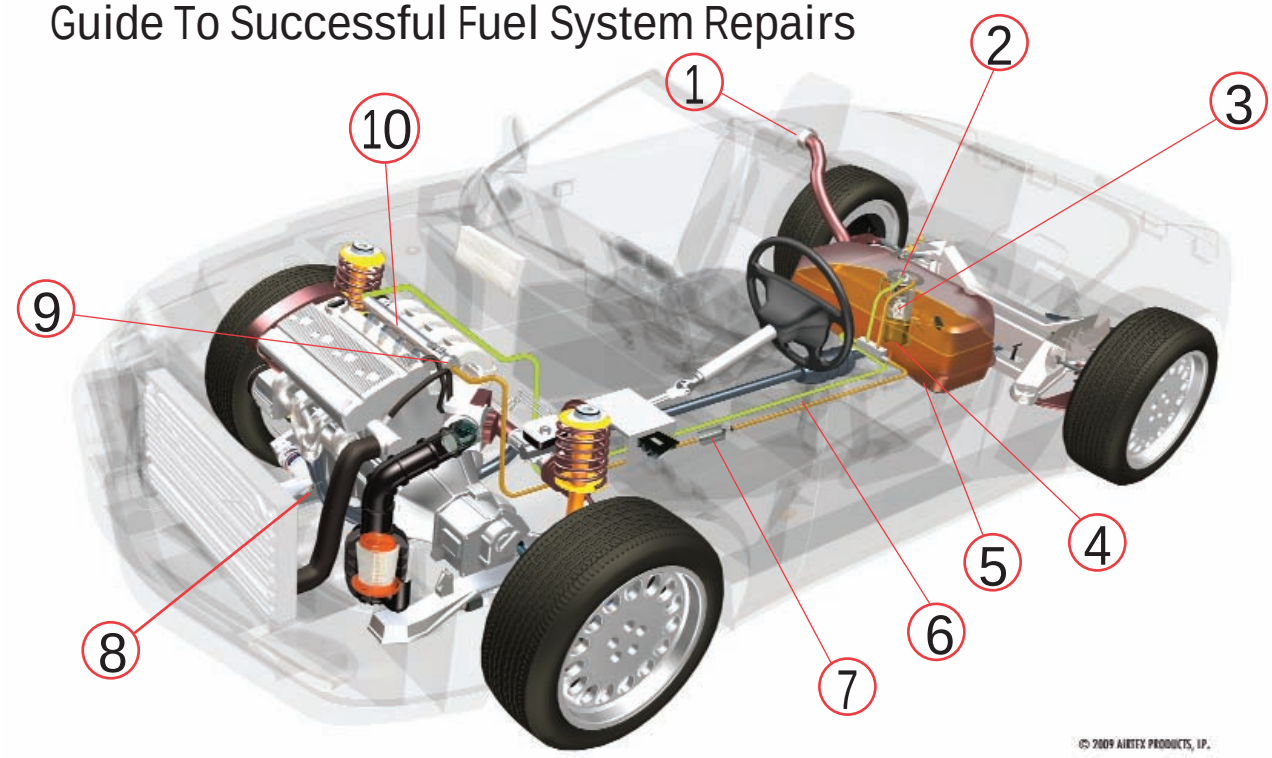
Fuel system repairs are often performed without proper diagnosis, leading to unneeded parts and the inconvenience of doing a complex repair that does not fix the vehicle's problem.

Fueled by
75 Years of Innovation

With 75 years of fuel delivery system expertise, Airtex brings a focused approach to new product development, using the latest technological advances in every fuel pump design. OE or better performance with coverage for over 212,000,000 vehicles on the road.

Trust Airtex.

Fuel System Delivery Overview — Guide To Successful Fuel System Repairs



1 Fuel Filler Cap
Tight seal is critical to proper OBD system operation. A loose cap can lead to a DTC that will set the "Check Engine" light.

2 Fuel Tank Pressure Sensor
Monitors fuel tank evaporative pressure for emissions control purposes.

3 Fuel Pump
The heart of the fuel delivery system, the fuel pump delivers fuel to the engine. Airtex fuel pumps are designed to meet or beat OE specs and are 100% tested to ensure performance and long-life.

4 Fuel Strainer
The pump's first line of defense against contaminated fuel. Failure to replace the fuel strainer will void fuel pump warranty.

5 Fuel Tank
The fuel pump on most modern vehicles is housed in the fuel tank. Tanks must be clean and free of contamination before a new fuel pump is installed. Contaminated fuel is responsible for 20% of fuel pump product failures.

6 Supply and Return Lines
Deliver fuel to and from the engine. Check for kinks or restrictions.

7 Fuel Filter
Protects injectors and engine from contamination not caught by the fuel pump strainer. Important to replace as a part of routine maintenance as well as with any fuel system service.

8 Oxygen (02) Sensor
Checks exhaust gases and sends signal to ECM to adjust fuel mixture for emissions control purposes.

9 Fuel Pressure Regulator
Controls fuel pressure to fuel injectors.

10 Fuel Injectors
Deliver fuel to engine combustion chambers.

It's important to note that the fuel pump is one part of a complex fuel delivery system. Any single component not operating properly can appear to be a fuel pump problem. Proper diagnostics are critical!

The Fix For Failing Fuel Pumps

Repeat fuel pump failures, which can cause major problems with your customers, are often caused by minor installation errors.

One common installation error is incorrectly replacing the pump inlet filters in such a way that it causes an inaccurate fuel gauge reading. In other cases, the fuel pump inlet filter may be blocked or dislocated by a dented or distorted fuel tank. These issues can be easily diagnosed by adding several gallons of fuel to the tank before testing fuel pump performance.

In a few rare cases, worn fuel pump relays can cause erratic or intermittent fuel pump operation. The cost of a new relay is minimal compared to the potential problems caused by a worn relay.

Fuel pump life can also be shortened on some vehicles if the owner habitually drives the vehicle on a nearly empty tank. Low fuel levels can cause the fuel pump to overheat by ingesting air when accelerating, cornering or stopping. Ingesting air can also momentarily reduce fuel pressure and cause fuel-related driveability complaints.

The Importance of Correct Volume

Fuel pump volume is equally as important as fuel pump pressure when testing for repeat failures. On the high end, several tool manufacturers supply testers that simultaneously measure the exact fuel pressure and flow while the engine is running. On the low end, most fuel pressure testers have a bypass valve that measures the excess volume flowing through the fuel pressure test Schrader valve. In most cases, this type of tester will provide a reasonable estimate of the volume of fuel flowing to the engine.

Under Pressure

When testing fuel pumps equipped with external fuel pressure regulators, it's important to test fuel pressure regulator performance by momentarily closing or restricting the return flow hose from the regulator to the fuel tank. This test will provide an indicator of maximum fuel pressure output that, in most cases, will be at least 150% higher than regulated pressure. Because crimping can damage braided hose and plastic lines, an alternate method should be used to close the return line.

If maximum pressure doesn't increase by momentarily closing the return line, the low fuel pressure might be caused by a worn fuel pump, a clogged fuel filter or crimped fuel line. If the fuel pressure is too high due to a crimped fuel return line or defective pressure regulator, the engine will normally run rich and the fuel pump amperage draw will be much higher than normal. The higher amperage draw will shorten fuel pump life and cause a repeat failure.

Fuel Pump Activation System

It's also important to evaluate the fuel pump's activation system. At the most basic level, the crankshaft position sensor supplies a signal to the PCM that indicates the engine is cranking or running. On many older vehicles equipped with distributors, the air flowing through the air flow meter closes a set of contacts in the sensor that, in turn, activates the fuel pump relay. In either case, the fuel pump relay won't activate without some type of engine speed input.

Tank Tie-In

Modern fuel tanks are difficult to clean because of their internal baffling. If a tank can be cleaned, it's important to use high-pressure soap and water to remove the dirt. The tank should then be thoroughly dried by circulating air through the tank or air dried outside.
In many cases, a fuel tank replacement is the most cost-effective and safe alternative for preventing repeat fuel pump failures.

Fuel Pump Diagnostics and Inspections

Scan It!

On late-model vehicles, it's usually much quicker to test the fuel pump with a scan tool that has the applicable bi-directional controls and data stream displays. If those features are available, a technician can quickly evaluate the fuel pump's electrical performance by using the scan tool to activate the fuel pump.

A scan tool should also be used to download trouble codes and data indicating if an anti-theft or other vehicle sub-system has disabled the fuel pump as part of its theft avoidance strategy. In some cases, the fuel pump circuit is disabled when the anti-theft system identifies an improper or defective key in the ignition switch.

Scan tools must also be used to diagnose pulse-modulated fuel pump systems. Because pulse-modulated systems are a story unto themselves, we can't illustrate an example in this brief space. In short, the Powertrain Control Module (PCM) tailors the fuel pump pressure to meet various operating conditions by controlling fuel pump speed, by pulsing electrical current to the pump. When the pulse width requirements exceed normal parameters, the PCM stores a fuel pump-related diagnostic trouble code.

Major causes of fuel pump failure include:

- **Misdiagnosis of the vehicle's problem;**
- **Rust, corrosion or other contamination in the vehicle's fuel tank;**
- **Clogged or plugged fuel filters and strainers; and**
- **Faulty on-vehicle fuel pump wiring or connectors.**

Electrical Issues

If voltage is available at the fuel pump, it's important to inspect the tank's electrical connector for looseness and burned connector pins. Repeat failures are often caused by connectors that were burned due to excessive amperage draw of a defective pump. If the fuel pump circuit is grounded to the frame, perform preventive maintenance by cleaning the frame and connector, and applying anti-corrosion compound to the connection.

When replacing a fuel pump, always:

- **Replace the filter or strainer with new;**
- **Professionally flush, clean or replace the fuel tank;**
- **Inspect, repair or replace suspect vehicle connectors and wiring; and,**
- **Refer to the Diagnostic/Troubleshooting and Installation Guidelines document found in the fuel pump box.**

The professional multimeter can be used to measure current flow through the fuel pump.

On most vehicles, a new fuel pump draws about three to five amperes of current. This amperage or current draw can be measured at the fuel pump fuse located in the vehicle's fuse box.

Many technicians also like to display the fuel pump current flow on an automotive lab scope to determine if the fuel pump armature and brushes are in good condition.

If current isn't flowing through the fuel pump, the fuel pump, fuel pump ground circuit, fuel pump relay or, if equipped, the fuel pump safety inertia switch might be defective.

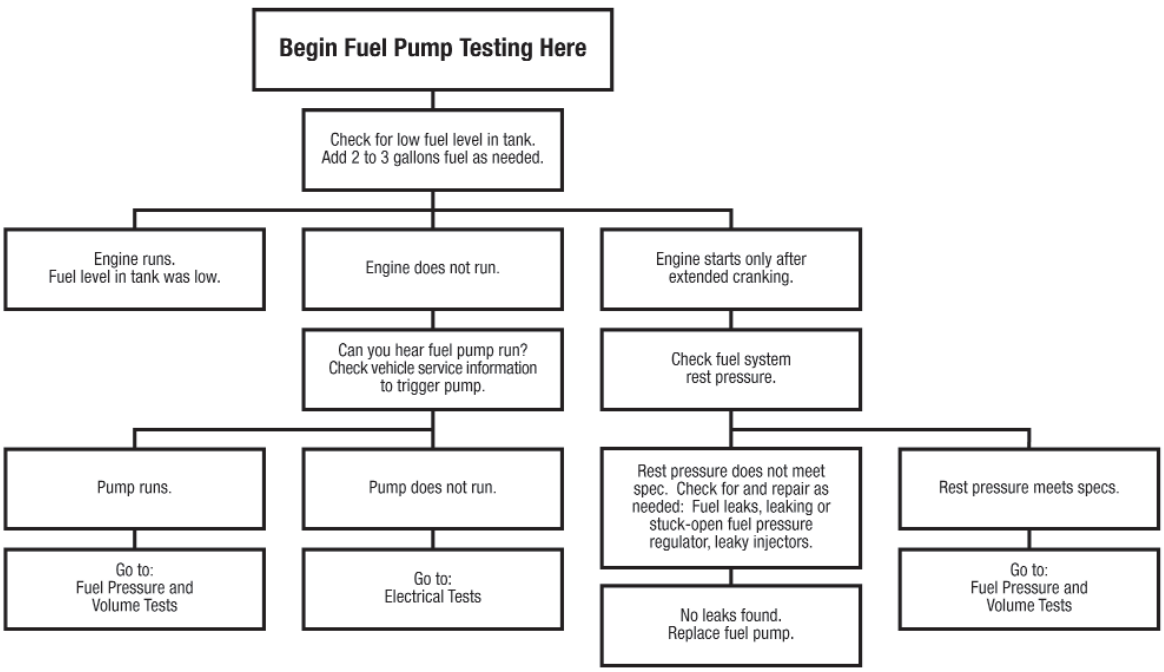
If current is flowing through the fuel pump, then it's highly likely that the external fuel filter might be clogged or that the filter sock attached to the fuel pump inlet might be clogged with dirt, rust or algae contamination.

While it might be strange to consider alge in the system, E85 and lower ethanol blends tend to be hygroscopic simply by their nature as alcohol-based. This can lead to a film of water on top of the fuel that collects algae and bacteria.

If current is flowing through the pump and the normal fuel pump operating noises aren't present, the inlet sock is probably missing and the mechanical part of the fuel pump is likely jammed with sand or other types of fuel tank contamination.

If the fuel pump's inlet filter is missing, torn or broken, make sure that the fuel tank baffle is securely attached to the fuel tank. Fuel pump failures have been caused by a loose tank baffle battering the fuel pump until the inlet filter fell way, allowing dirt to jam the pump assembly.

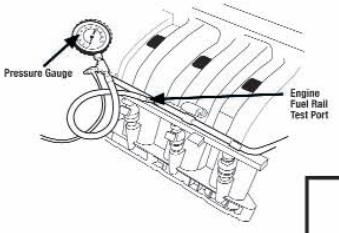
FUEL DELIVERY SYSTEM DIAGNOSTICS



Fuel Pump Voltage Test

1. Connect digital voltmeter to fuel pump wiring at fuel pump connector.
2. Turn key on (pump will only voltage only for a few seconds).
3. Measure voltage at pump. Reading should be within 0.5v DC of system voltage.

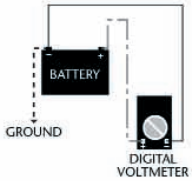
FUEL DELIVERY SYSTEM DIAGNOSTICS



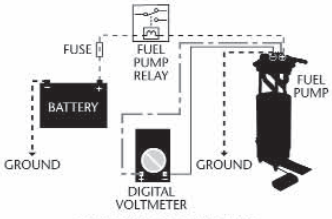
Fuel Pressure and Volume Tests

Install fuel pressure gauge and trigger fuel pump.

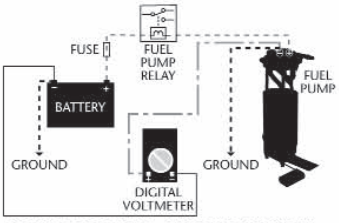
- **Low or no fuel pressure.**
  - Check for and repair as needed: Plugged inlet filter or strainer, restricted fuel supply, fuel leak, leaking or stuck-open fuel pressure regulator, wrong pump installed, fuel tank damaged.
  - Pump runs.
  - Go to: Fuel Pressure and Volume Tests
- **Fuel pressure meets specs.**
  - Check fuel volume. Do not check volume at Schrader valve.
    - Pump does not run.
    - Volume does not meet specs. Check for and repair restrictions in fuel system.
    - Go to: Electrical Tests
- **High fuel pressure.**
  - Check for and repair as needed: Plugged fuel filter, restriction in return line, fuel pressure regulator stuck-closed, wrong pump installed.



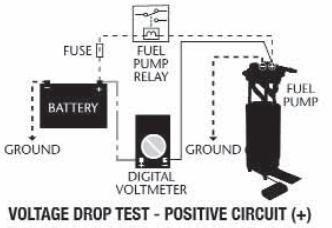
SYSTEM VOLTAGE TEST



FUEL PUMP VOLTAGE TEST



VOLTAGE DROP TEST - NEGATIVE CIRCUIT (-)



VOLTAGE DROP TEST - POSITIVE CIRCUIT (+)

Electrical Tests

Check battery voltage. Minimum 12.4 volts. Minimum 9.6 volts at starter when cranking.

- **Battery voltage OK. Energize fuel pump. Check voltage at fuel pump side of fuel pump connector. Must be within 0.5 volts of battery voltage.**
  - Voltage at fuel pump connector within 0.5 volts of battery voltage. Check separate negative and positive circuits for maximum of 0.5 volts voltage drop each.
    - Voltage drop less than 0.5 volts each. Replace fuel pump.
    - Voltage drop more than 0.5 volts. Check for a repair/replace loose, corroded or burnt connectors, wiring or grounds.
  - No voltage. Check for and repair: Armed alarm system or anti-theft device, blown fuse, faulty fuel pump relay, lack of RPM signal, lack of oil sender signal, tripped inertia switch, faulty fuel pump control module, faulty ignition switch, faulty fuel pressure sensor, faulty vane type air flow sensor.
- **Battery voltage less than 12.4 volts. Charge or replace battery. Check/repair battery cables, connections, charging system.**

Fueling World-Class Technology

Designing Innovative Fuel Delivery System Products for 75 Years

Airtex takes a focused approach to new product development, incorporating the latest technological advancements in every product. With OEM or better performance and coverage for over 212,000,000 vehicles on the road, Airtex manufactures world-class fuel delivery system technology.

OE SUPPLIER™

TRUST Airtex