Foreign Service

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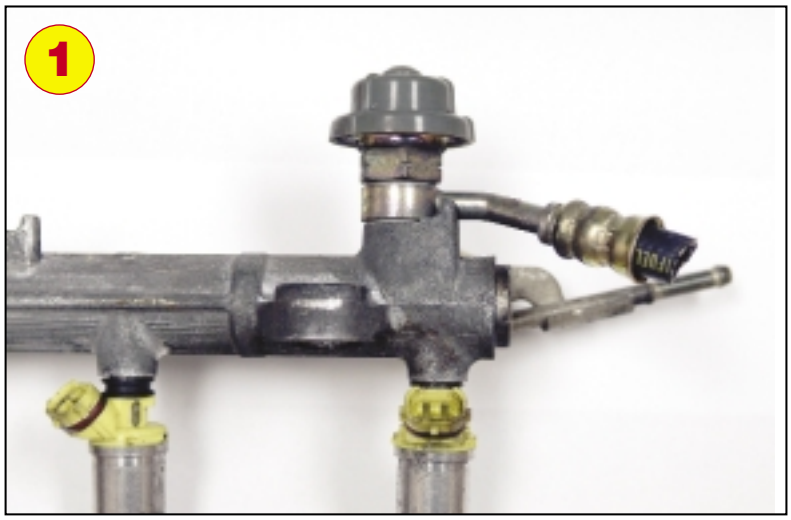
When a normally reliable component fails, it can put a 'damper' on a quick diagnosis, especially if the symptoms are missed or misinterpreted.

Toyota has used dampers on its fuel injection systems for years. But if you're like most technicians, you haven't looked twice at a damper because it's normally very reliable. Trouble is, when a damper finally does fail, it often confuses and frustrates uninformed technicians.



Photos: Dan Marinucci

This month I'll explain how a fuel damper works and well as what can go wrong with it. There are plenty of these dampers in service, and you don't want a bad one fooling you!

At one time or another, everyone has heard a water pipe in a house begin to bang after someone opens a faucet and closes it suddenly. If the banging pipes bother you enough, you can source a little hydraulic damper from a hardware store or home center and tee it into the noisy pipe. Basically, this kit acts like a hydraulic shock absorber on the water pipe, dampening the effects of the sudden pressure change inside the pipe.

The fuel damper on an injector rail (photo 1 at left) also serves as a hydraulic shock absorber of sorts. Electric fuel pumps don't produce a totally smooth, seamless flow of fuel. To the contrary, fuel pump output pulses, and ultimately this pulsing can cause noises downstream in the fuel rail. Of course, the risk of hydraulic noise in the fuel system varies from vehicle to vehicle and system to system.

On older Toyotas, you might see a fuel damper mounted right at the fuel pump outlet. But the most common location for it is at the fuel rail inlet. The damper contains a spring and diaphragm that absorb some of the shock of the fuel pulsing into the fuel rail. When the system is working correctly, fuel pressure lifts the diaphragm, pushing it up into the damper housing. Pushing back this diaphragm allows the fuel to continue flowing into the fuel rail.

If you pry off the plastic cover that's pressed onto the top of the fuel damper, you'll find a factory-set adjustment screw (photo 2). This screw limits the travel of the diaphragm inside the fuel damper. Ordinarily, this adjustment is set for life and you certainly don't want to experiment with it. This screw also provides a quick-and-dirty fuel pressure check. When there's no pressure in the system, the screw sits down against the recess in the damper cover. But when fuel pressure *is* present, it lifts the damper's diaphragm enough to push the screw noticeably outward.

Visually checking the position of this screw is no substitute for a proper pressure/volume test. It's an all-or-nothing proposition: When there's no pressure, it's recessed; when there is pressure, it protrudes. But it doesn't tell you *how much* pressure, or if the pressure is stable under load.

Leaks are the most common Toyota fuel damper failures. When you investigate a customer's complaint about a gasoline odor, you may find fuel is seeping out of the fuel damper. Watch for gasoline stains on and around the fuel damper. Replace it if it's seeping fuel.

Occasionally, the adjustment screw loosens up, allowing the diaphragm to stroke too far downward. When this happens, the damper's diaphragm restricts fuel flow, causing a severe lean condition during acceleration. When the driver punches the gas pedal, the engine falls on its face with a severe hesitation (sometimes almost stalling), bucking, chugging or surging. When he backs off the throttle, the engine runs better because enough fuel flows to satisfy it during light-throttle driving.

Remember that fuel pressure has to push this diaphragm upward into the damper assembly before gas will flow into the fuel rail. But when the diaphragm has "overtraveled" due to a loose adjustment screw, fuel pressure just can't push or lift it enough to provide normal volume to the injectors. I'm not aware of any quick, reliable way to reset this diaphragm travel adjustment back to original. Replacing the fuel damper itself is the safest, surest fix.

An episode at Tom Dwyer Automotive Service in Portland, Oregon, illustrates how potentially confusing symptoms can be when that factory-adjusted fuel damper screw loosens up. Technician Steve Poole was troubleshooting a 1995 Toyota V6 truck with the same lean symptoms I described earlier. The truck's fuel filter and fuel pump had already been replaced.

Poole followed the fuel line up from the frame-mounted filter and found a threaded junction in the fuel line down on the right inner fender panel. He teed a pressure gauge into this junction, which happens to be well upstream from the fuel rail inlet and the fuel damper. First, the system passed a simple vacuum-applied/vacuum disconnected test of the fuel pressure regulator.

Poole's experience taught him to verify that fuel pressure was stable under load. Considering how severe the lean symptoms were, Poole expected fuel pressure to drop like a stone during acceleration. *Surprise!* Fuel pressure didn't drop at all! Then, when Poole checked fuel volume at the pressure regulator outlet port, the truck did more than just fail the volume test miserably. He noticed there was hardly any fuel flowing from the return side of the system.

A quick check of injector pulse width showed that the ECM was increasing pulse width substantially when Poole snapped the throttle open. Furthermore, feeding the engine some propane through a vacuum port during acceleration perked the engine up considerably. So what the heck ailed this engine? Dirty injector inlet screens might cause a severe lean condition, but Poole wondered if all six injectors could be restricted *that* badly. Plus, that still wouldn't explain the extremely low fuel volume in spite of a new fuel pump and filter.

Poole studied the system a little longer and noticed the fuel damper on the injector rail. He told me he had seen a number of these dampers seep fuel, causing gasoline odor complaints. But he also wondered if something was somehow hanging up the damper diaphragm, causing it to malfunction when the system was under load.

He removed the truck's fuel damper and inspected it as well as the opening into the fuel rail. Everything looked clean as a whistle, so he tried a new fuel damper; that fixed the truck. Hindsight is always 20/20. Poole said that if he had been thinking more clearly, he could have compared the upstream fuel pressure reading to one taken downstream of the fuel damper.

Poole's a good sport. I told him that the next time he encounters these lean symptoms during acceleration on a Toyota or another similarly equipped vehicle, he would be better prepared. When the driver asks what might be wrong with his car, Poole could respond with a straight face: "You may have a screw loose somewhere." M