

Foreign Service



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Dan concludes his *magnum opus* on Toyota's evap system with a final chapter on the LEV-II system, which has some differences and many similarities to the carmaker's other evap systems.

This Toyota evaporative emissions series began back in January 2006. I'll conclude it this month by explaining the LEV-II evap system. But before we begin, be sure you have this year's Foreign Service columns handy. Referring back to them will simplify this month's subject tremendously.

Also, forgive me for a mental lapse in reversing the coverage of these last two evap designs. The key-off vacuum pump system, which I covered in the September issue, came on the market *after* LEV-II did. I think you'll find that LEV-II is basically a refinement of the intrusive evap system I discussed in the June and July 2006 columns. However, LEV-II does share some details with the key-off system, too.

The following vehicles are equipped with the LEV-II evap system:

- 2000-04 Echo
- 2003 Camry (2.4L, 2AZ-FE engine)
- 2003-04 4Runner, Tundra
- 2004-05 Camry, Scion xA and xB
- 2004-06 Highlander (1MZ-FE engine), Sienna, Solara.

LEV-II System Components

Okay, let's see where LEV-II is like or unlike the other Toyota evap systems I covered this year. The front door of LEV-II is the familiar purge VSV (vacuum switching valve) that we've seen under the hood of other Toyota vehicles. It works just like the other purge VSVs and the OE-style scan tool software still identifies this component as an *EVAPVSV*.

The heart of the system, the charcoal canister assembly, will probably cause its share of headaches because it's buried somewhere under

the vehicle, usually in the rear. For example, photo 1 at left shows how the LEV-II canister on the Camry, Toyota's hottest-selling car, is hidden *above* the rear crossmember. Anyway, follow the system from the purge VSV back toward the canister and you'll find that most LEV-II systems still have the green evap service port. You'll also see lots of that plastic evap tubing that I described in the September column. Yes, this is the tubing that shouldn't be pinched or crimped off during evap system leak diagnosis.

Canister access may be limited, but at least this canister assembly is much simpler than those used on earlier evap systems. For instance, Toyota discarded the two bulky diaphragm-equipped valves from the

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Photos & illustration: Dan Marinucci

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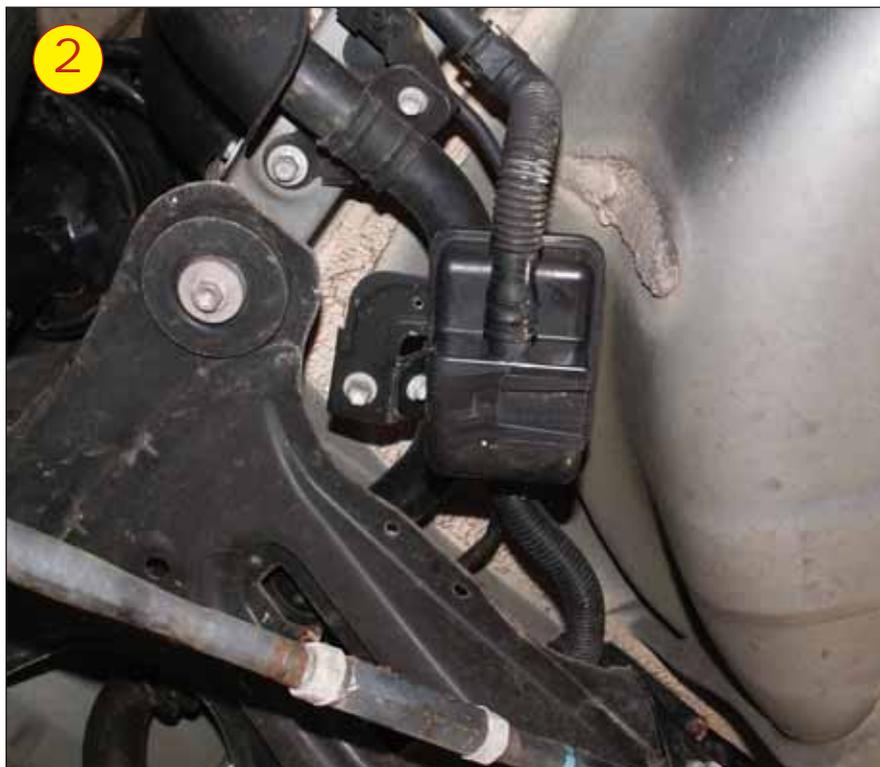
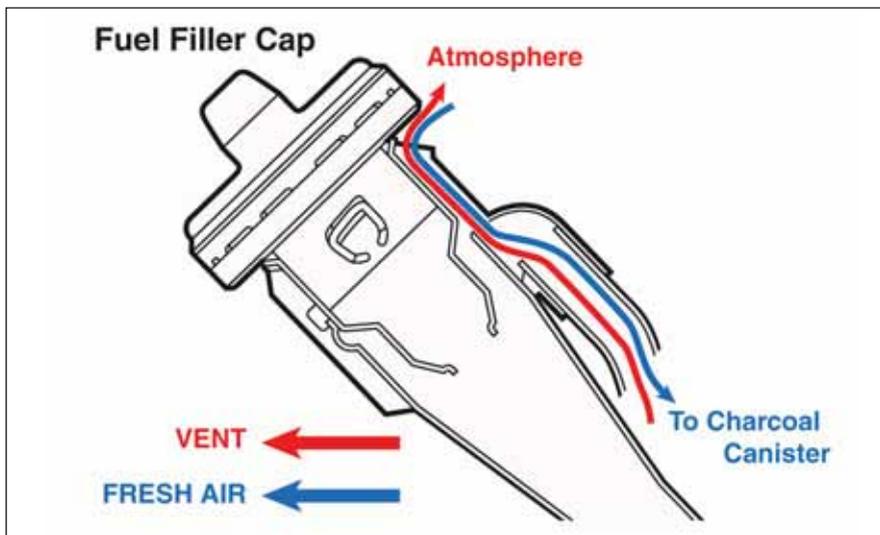
canister (shown in photo 2 on page 16 of the January issue). Removing these valves also eliminated the air drain hose and its related issues. The air drain hose is shown on page 20 of the February issue of *MOTOR* as well as page 16 of the May issue.

However, Toyota also added a refueling valve and canister-closed VSV (commonly called the CCV) to the LEV-II canister assembly. The refueling valve is the same one the key-off vacuum pump system uses. It's the round, diaphragm-equipped valve shown in photo 2 on page 14 of the September issue. This simple valve, which is normally closed, is plumbed in series between the fuel tank and the canister. When you fill the tank, the resulting increase in fuel tank vapor pressure opens the refueling valve, releasing fuel vapors into the canister.

Whether you're working on a LEV-II or key-off evap, remember that there's a fixed, calibrated leak inside the system. You see, the refueling valve has a fairly large vapor hose connected to it, but its size is deceptive. An .080-in. restrictor inside the refueling valve limits the volume of fuel vapor that can flow from the tank, through the valve and into the canister. It also limits the impact of engine vacuum on the fuel tank during the purging process or when the evap monitor runs. This restrictor effectively replaces the bypass VSV used in the intrusive evap system. The bypass VSV is shown on pages 16 and 18 of the June 2006 issue of *MOTOR*.

Stay alert, now! The restrictor creates a normal, constant leak between the canister and fuel tank that may complicate a leak diagnosis. For example, the only definite way to isolate the tank side from the rest of the system may be to disconnect and temporarily plug the tank-to-refueling valve hose. It also underscores the value of using an evap-approved smoke machine to pinpoint leaks on LEV-II.

On earlier Toyota evap systems, atmospheric pressure (762mm/Hg) in the fuel tank often indicated a leak. But as long as the engine isn't purging the system, normal tank pressure in a LEV-II or key-off evap system is atmospheric pressure. This happens



because the restrictor allows the tank to "breathe" through the canister.

As long as we're discussing system pressures, this is a good time to tell you that the LEV-II vapor pressure sensor works like those on earlier evap systems. Its signal is about 3.33 volts at atmospheric pressure. The sensor is usually on or near the fuel tank.

If the purge VSV is the front door of the entire evap system, then the

canister-closed VSV is the system's back door. On the intrusive evap system, the CCV was located under the hood (see photo 2 on page 18 of the June issue). The CCV on LEV-II works the same way as it did on the intrusive system, but it's been relocated back to the canister assembly.

The vent or "breather" side of LEV-II is just like the key-off vacuum pump system. For instance, instead of drawing

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fresh air from the engine's air filter housing, LEV-II breathes through a vent near the top of the fuel filler tube (see the illustration on page 14). There's also a serviceable air filter in the fresh air line going back to the canister assembly. This fil-

ter, which doesn't have a scheduled maintenance interval, is usually located fairly close to the canister assembly (photo 2).

LEV-II has something else in common with the key-off evap I covered in September's column. A restricted fresh-

air circuit—including a dirty filter—ultimately could trigger trouble codes for a purge-side or vent-side restriction.

Troubleshooting Tips

Back in July's column, I gave you a detailed description of a simple, functional test of the intrusive evap system. Now that you know the differences between the LEV-II and intrusive systems, you can apply much of that format to LEV-II diagnosis. The main difference is that LEV-II has a constant, calibrated leak between the canister and the tank.

Here's an easy example. Like other Toyota evap systems, the LEV-II begins purging at idle after the engine warms up. Suppose you warm up the engine, let the evap system purge and then close the back door (energize the CCV with a scan tool or a jumper wire). Experience shows that under these test conditions, the engine should pull a healthy LEV-II system down into the range of 730-something mm/Hg. If it does, it indicates there are no *major* leaks.

If the engine doesn't pull a decent vacuum here, divide and conquer to the best of your ability. For instance, remove the fuel tank hose from the refueling valve and close off that port on the valve with a plug or rubber cap. Energize the CCV again while the engine is purging the evap system. Do you see a healthy vacuum reading now? If you do, it proves the leak is on the fuel tank side of the system.

Richard Escalambre, Professor of Automotive Technology at Skyline College in San Bruno, CA, offered some advice on running the LEV-II system's evap monitor. He's the Toyota ace who provided the ECT and IAT sensor substitution info for August's Foreign Service column on running Toyota monitors. There is a procedure for running the LEV-II system monitor by idling the engine. But Escalambre said his experience with the idle format has been very inconsistent. A simple, consistent way to run the LEV-II monitor is to run the vehicle on a dyno or on a lift. Warm the engine up, slowly accelerate to 45 to 55 mph and hold that speed until the monitor finishes running. This procedure has been consistently successful, he noted. **M**

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