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SMOKE OUT THOSE LEAKS!

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SMOKE SIGNALS

By Dan Marinucci

Smoke-generating machines have continually evolved and improved. Almost unknown just a few years ago, this technology is now OE-approved and, in many cases, mandatory. Here's an overview of this leak-detection method today.

This story starts out simply enough. I first used a smoke machine in the spring of 1995 and loved it, so I included it in a feature story on leak detection in our June 1995 issue. I also began recommending the technique to anyone and everyone who'd listen. Those who took my advice always responded, "Gee, I wish I'd gotten a smoke machine sooner!"

Since then, smoke technology has come a long way both inside and outside the automotive industry. For example, it's been used to diagnose fuel tank and fuselage leaks on jet aircraft. It's been used to quality-check new tanks for over-the-road tanker trucks and to diagnose high-pressure leaks in nuclear power plants.

In the auto repair business, the cost of labor, increasing complexity of vehicles and limited access to many components have all made smoke technology more important and cost-effective than ever.

Longtime smoke machine users emphasize that the equipment lends itself to demonstration to skeptical car owners. Simply put, smoke signals have proven to be a very powerful, convincing service sales tool.

Even if you *have* used one, stay tuned anyway. Enhanced evaporative emissions systems have forced major upgrades in the smoke technology that you need to understand. We'll try to update you on the types of smoke machines available and how they're used.

General-Purpose Smoke Machines

As the name suggests, general-purpose smoke machines are used to diagnose leaks all around a vehicle. The lone exception is evaporative emissions systems, which I'll discuss later. A typical general-purpose machine creates smoke, pumping it at approximately 1.00 to 1.50 psi. If the smoke pressure exceeds this for any reason, a regulator inside the machine vents off the excess pressure. In the case of the original Vacutec unit, you knew this was happening when you saw smoke streaming from an overpressure port on the back of the machine.

For many smoke machine users, this overpressure vent has been a simple but very effective diagnostic tool. For example, I pump smoke into a vacuum brake booster when I suspect it's leaking. Obviously, that smoke has to go somewhere. If the machine continues pumping smoke, there's a leak in that booster somewhere. But if the booster fills up and then the smoke blows out the machine's relief vent, you know the booster is tight—otherwise, smoke pressure wouldn't have gone high enough to pop open the relief valve.

This pressure-venting system makes it extremely unlikely that a smoke machine would actually create a leak or damage any component due to excessive pressure. Nonetheless, be sure to read about sensitive evap system pressures later in this article.

Modern machines have user-refillable smoke chambers or reservoirs that last anywhere from 200 to 300 tests. A good rule of thumb is that the newer the model, the better the quality and quantity of smoke it produces. Better-quality smoke is denser, thicker and whiter, which means it's much easier to see during a leak test. Higher-quantity smoke speeds up the test appreciably when you're filling something relatively large, such as an exhaust system, air intake or big vacuum reservoir.

A few general-purpose machines produce smoke with ultraviolet (UV) dye in it. So if somehow you overlook the smoke streaming out of the leak, the smoke will also leave a telltale stain you can see with a UV-type spotlight. Speaking of spotlights, some smoke machines come with a powerful halogen spotlight that's invaluable for pinpointing "smoke signals" during a leak test. This 12-volt

Photo: Craig DeBoer

Finding leaks such as on this Ford EGR valve stem requires judgment and experience. For example, veteran smoke machine users say this valve usually is suspect. But they say the valve should not be considered defective if it allows smoke to escape only with the throttle housing capped off.

spotlight has an extra-long cord that allows you to walk the length of the vehicle with it, if necessary.

Leak-Testing

Finding vacuum leaks in the engine and related vacuum systems is the single most popular application for general-purpose smoke machines. The most-common technique is to leak-check the engine with the engine off and the throttle closed. Disconnect the hose from the PCV valve and pump smoke into the PCV hose. If it's easier to reach, disconnect the vacuum hose from the power brake booster and pump smoke into that hose. If you do this, remember to also smoke-check the power brake booster itself.

Some techs routinely do this on every engine as a quick state-of-health check because it takes so little time. They're repeatedly amazed, they tell me, at the leaks they find on supposedly tight engines that have no symptoms or trouble codes...yet. The tech carefully notes the condition on the work order, explaining that the leak won't heal itself. Then, at the very least, he or she tries to schedule another appointment for the actual leak repairs. That additional work is found money!

Obviously, we deal with ECMs today that work overtime compensating for rich and lean conditions. Unless they're monitoring their fuel consumption very closely, many motorists don't notice anything's wrong until the MIL or Check Engine light comes on. A smoke machine will catch vacuum/air leaks long before they cause a trouble code.

Other techs do the basic engine smoke check when there is misfiring, rough idling or any kind of lean-condition symptom such as the classic P0172 code. Sure, this code confirms that the computer is driving the mixture richer in response to some kind of lean condition—but *which* lean condition? Restricted fuel filter? Unmetered or "false" air? Dirty injectors? Here again, experienced driveability techs using smoke machines agree that the basic engine smoke check described earlier is so fast and effective it doesn't make sense *not* to do it first! That way, they eliminate vacuum leaks from the lean-condition search right away.

At Stock's Underhood Specialists in Belleville, Illinois, driveability veteran Paul Stock succinctly summed up this approach: "No matter how sophisticated these vehicles become, our job is still a big, logical process of elimination—separating the knowns from the unknowns under that hood. I've watched too many guys run themselves in a circle because they don't qualify the known things first," he explained. "When the smoke machine quickly establishes that there are no air leaks, that's an extremely valuable 'known' to anyone diagnosing a lean condition."

Meanwhile, let's return to this basic test. You can usually fill an engine with enough smoke for an adequate vacuum-leak check in 60 to 90 seconds. Then grab your halogen spotlight and patiently inspect the engine and its vacuum plumbing for smoke signals. Among techs who use smoke machines extensively, the consensus is that the more you use the machine, the quicker you'll spot leaks—including the smaller, more elusive ones—and the easier it will be to make discretionary calls on certain leaks.

This basic engine check reveals two kinds of air leaks—those that have already caused a symptom and those that will *eventually* cause a symptom. And smoke repeatedly pinpoints air leaks that would be extremely difficult to find via other means.

For example, John Bradley at Sawchuk's Garage in Pottstown, Pennsylvania, showed me an intake gasket leak *under* the intake manifold of an LH Chrysler V6. This car idled rough and flunked the emissions test due to excessive HC, etc. Within minutes, Bradley proved it was gasket time because smoke was pouring out of the valley of the engine.

"Some guys still leak-check with

The goodies in front of this evap-approved smoke machine are as important as the machine itself: tapered black cones for checking exhaust or cooling systems, a diffuser for diagnosing wind/water leaks from the outside of the vehicle, an adapter for the standard evap-system Schrader service port, various yellow caps for blocking off passages and a high-intensity halogen spotlight for identifying smoke signals.

Photo courtesy SPX/OTC

propane or spray carb cleaner," Bradley observed. "But how would you pinpoint the exact location of that Chrysler's leak with those old methods?"

Bradley explained how helpful it is to smoke-check the individual vacuum circuit related to the vehicle's symptom. Recently, this approach flagged a rusted-out vacuum reservoir on a Ford truck that might have taken a long time to pinpoint with other methods. These coffee can-shaped vacuum reservoirs are often hidden far out of sight on Ford products.

Time and again, smoke signals have proven to be an ideal "flag" for problems such as a disconnected or cracked vacuum hose, cracked plastic vacuum fitting or vacuum switch, leaking injector O-ring, loose or cracked intake air duct, leaking EGR valve or EGR gasket—the list is endless!

Cracked intake air tubes or ducts can be particularly frustrating because the cracks may be so difficult to see. To see if a cracked air duct is causing a lean condition, perform the basic engine smoke check described earlier, but with two changes: First, prop the throttle open with a throttle-holding tool. Second, cover the air cleaner inlet opening with plastic kitchen wrap and a rubber band. Or, if it's easier, open the air cleaner box, remove the air filter element and carefully wrap it with plastic wrap. When you reinstall the filter element, the wrap will effectively seal off the inlet of the air ductwork.

Now see if smoke creeps out of the intake air ductwork anywhere. Sometimes you have to rap on the duct with your knuckles or shake the duct a bit to open up the crack.

Many smoke users like the fact that smoke is more precise than some other methods. For example, in an engine that idles rough, the EGR valve may be fairly close to the intake manifold gasket and the engine may speed up when you spray carb cleaner or flow propane in this area. But which one is really the culprit—the intake gasket, EGR valve or EGR gasket? A smoke signal will show you *exactly* which one is leaking. What's more, if your general-purpose smoke machine has UV dye in it, the dye will leave a telltale stain at the leak.

On the Chrysler V6 leak mentioned earlier, the entire intake manifold is separate from the valley of the engine. However, I've seen some goofy vacuum leaks on traditional V8s on which the bottom of the intake manifold covers or seals off the valley of the engine. For example, a performance enthusiast's car had a combination of symptoms such as extremely rough idle, abnormal oil consumption and power brake problems. Although visual inspection suggested that someone had been into this engine, the owner neglected to say that he'd been experimenting with various cylinder heads and intake manifolds. After pumping smoke into the PCV hose, smoke eventually billowed out of the crankcase breather hose. I'd seen this before—a leak from the intake manifold into the valley of the engine.

When I removed the intake manifold, the "witness marks" showed that the lower edge of the manifold wasn't sealing properly against the lower edge of the intake ports. That's how smoke ended up inside the crankcase. This also explained the extremely rough idle, the oil consumption and the poor power assist from the power brakes. A three-minute smoke check pointed me exactly where I needed to go.

If the tech in the next bay is using the shop's cylinder leak-down tester, pumping smoke into a cylinder is also an effective way to pinpoint a bent or burnt valve.

Finding Exhaust, Oil & Coolant Leaks

A typical smoke machine comes with a relatively soft, cone-shaped adapter that's ideal for smoke-testing exhaust systems. Raise the vehicle on a lift, stuff this cone in the tailpipe and give the machine about two minutes or so to fill the exhaust system with smoke. You may be surprised at how quickly you can check the exhaust system without having to run the engine, partially block the tailpipe, burn your hands feeling around for leaks, etc. Some guys claim a leak will always create a telltale black, sooty trace outside, but don't count on it.

In fact, the smoke machine will detect the smallest exhaust leaks early on—before you or the driver can even hear them. Show these leaks to the vehicle owner and note them on the work order.

The smoke technique also makes

Photo: Tom Schilder

Once you start using smoke to pinpoint exhaust leaks, you'll never work without it again. Here, the mechanic's mirror shows a telltale plume of smoke emanating from a leaking exhaust gasket on a Toyota Tacoma.

quick work of diagnosing those dastardly cracked exhaust manifolds. Occasionally, you may need a mirror to distinguish between a leaking manifold gasket and a cracked manifold, and some leaks show up more readily when the exhaust is cold. But the point is that smoke signals won't lie when you're chasing down exhaust noises.

Many smoke machine users routinely diagnose oil leaks with it. To be entirely fair, the technique isn't 100% effective for this task. But as one longtime user put it, "The smoke machine identifies three or four out of every five oil leaks. To me, that's a good batting average. Also, it reduces the amount of fluorescent dye we're using to find leaks," he said.

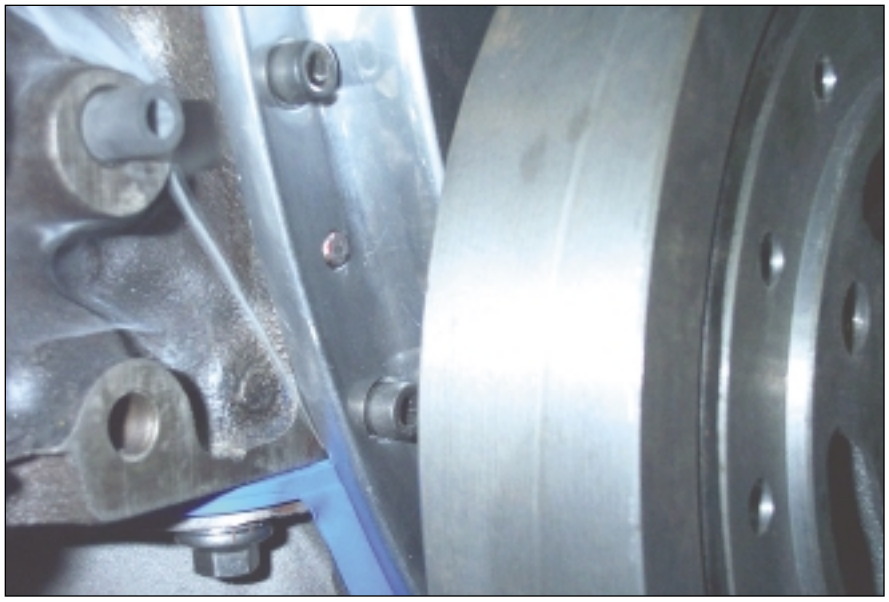

Photo: Glenn Richardson

Smoke is a great quality-control technique, especially on gasket jobs. Here, smoke streams from a folded-over pan gasket. Good thing this tech caught the mistake on the engine stand before reinstalling this freshly overhauled engine!

To do an oil leak check, you must effectively seal off the crankcase so the smoke machine can pressurize the engine properly. This means plugging or sealing off items such as the PCV hose, crankcase breather hose, etc. Sometimes plastic kitchen wrap is all you need to do this. Then remove the dipstick and oil filler cap and begin pumping smoke into the dipstick tube. When you see a healthy stream of smoke coming from the oil filler opening, reinstall the oil filler cap and let the smoke machine pressurize the crankcase. Next, watch closely for clues such as a definite smoke signal or oil dripping and/or bubbling out of the leak. If your machine is equipped with UV dye, the dye gives you a third way to spot the oil leak.

We've all battled oil leaks that began on the left side, ran along the engine and dripped off the right side—or something similar. A smoke signal is a timesaver because it flags the origin of the leak instead of the place where it finally drips off. A quick smoke test is also a great quality-control check on a seal or gasket replacement.

At Fadely's Automasters in York, Pennsylvania, Tom Fadely encountered an earlier Corvette that seemed to be spewing oil everywhere. The 'Vette's owner told him he was apprehensive because other shops wouldn't commit to what it would actually cost to cure the leaks. During the routine smoke check, smoke came out of the timing cover, the vent hole in the mechanical fuel pump and the bellhousing (rear main seal leak). Fadely told me that as soon as the owner saw the results of the smoke check, he readily authorized the repairs. Furthermore, the smoke signals were dead accurate, Fadely said.

Today's engines seem to have plumbing everywhere, including those pesky plastic or steel coolant pipes. The smoke machine may not be 100% effective on coolant leaks, either, but many users rave about its ability to quickly flag routine leaks. They drain the system, pump smoke into the radiator neck and look for smoke signals among the myriad of hoses and connections under the hood. One tech

Photos: Dan Marinucci

A smoke machine can save countless hours diagnosing oddball problems such as a leak inside a vacuum-controlled heating/air conditioning system. Here, smoke streams out of a small vacuum leak inside the dashboard that might have taken a long time to pinpoint using traditional methods.

even uses smoke to leak-check intercoolers on turbocharged engines.

At Stock's Underhood Specialists, Paul Stock stressed the smoke machine's effectiveness at pinpointing the origin of a coolant leak that begins way over *there* but drips off the engine way over *here*. In many cases, Stock noted, the smoke machine has saved him the hassle of tying up a lift in order to find a coolant leak.

Tom Fadely also praised the smoke check for identifying leaks in hard-to-see hoses and connections. In the most recent case, he saw coolant under the intake manifold of a Ford V6. A smoke check confirmed that the source was a hole in a coolant tube that disappeared under the intake manifold. The bottom line is that a cooling system that leaks with only 1.00 to 1.50 psi pressure of smoke will surely leak with 15.00 psi of coolant pressure.

Diagnosing Other Leaks

Technicians use everything from recycled refrigerant or nitrogen to compressed air to diagnose leaking air conditioners. Surely, smoke isn't the best technique, but Fadely told me that smoke is so cheap and easy he's using it as a first check on empty air conditioners. Often, the leaks are large enough that the smoke easily flags them. For example, he was checking a GM vehicle on which a high-side refrigerant line disappeared under the battery box. Apparently, battery fumes and/or leakage had corroded a pinhole in this line. The smoke pinpointed it in seconds.

A smoke diffuser, included with many smoke machines, makes it easier to detect wind and water leaks. Here, a small air leak at the window is blowing the smoke upward. With some practice, you'll learn to recognize how the smoke reacts to an air leak.

Earlier, I explained how John Bradley "smoked out" a rusted Ford vacuum reservoir that was well-hidden. Likewise, collision repair techs have war stories about smoke locating cracked vacuum reservoirs buried inside fender panels or under the vehicle. For instance, one vehicle had a vacuum-controlled heating/ventilation (HVAC) system that didn't operate properly after collision repairs were performed. The tech diagnosed it quickly by pumping smoke into the HVAC system's vacuum supply hose and watching for smoke signals. The smoke usually appears somewhere *outside* the dashboard!

If you're diagnosing vacuum-operated headlamps, you don't want to tackle another one of those jobs without a smoke machine. European-car specialists who work on vacuum-operated Mercedes door locks say a smoke machine saves them untold hours of troubleshooting time.

Many smoke machines come with a simple diffuser attachment that makes the smoke easier to use on wind and water leaks. The trick here is to move the vehicle into a calm work area where there's no interference from shop ventilation fans or windy weather outside. Select the Fresh Air position on the ventilation controls and put the blower fan on its highest speed. You want the fan to suck fresh air and then pressurize the interior with it.

Now, patiently walk around the car, blowing smoke at the window and door seams with the diffuser attachment. This technique takes some practice. But when you reach an air leak, the positive air pressure leaking from the vehicle's cabin will literally blow the smoke away! Try practicing on a known-good car, then repeat the check on the same car with a window cracked open a tiny bit.

Beware, the origin of a wind or water

I pressed the .040-inch leak Reference button on this Snap-on fully electronic evap-approved smoke machine, then aligned the little red flag on the left with the ball inside the flow gauge. If the ball rises above the red flag during the actual leak test, I know the evaporative emissions system has a leak greater than .040 inch.

The Calibration buttons on a fully electronic evap-approved smoke machine establish a reference point for different-size leaks with the ball inside the flow gauge. To perform the actual leak check, press the Test button and see if the ball in the flow gauge rises above the established checkpoint. To produce smoke, press the Smoke button.

Photos: Dan Marinucci

leak is often far away from wherever the driver thinks he hears it or where he actually sees the water dripping.

Evaporative Emissions Smoke Machines

Within the last 25 years, changing technologies have forced us into more and more advanced test gear. As vehicle systems progressed, we began using digital voltmeters, then scanners, then digital oscilloscopes and so forth.

Likewise, evaporative emissions systems have changed a great deal from the relatively simplistic designs in use when the first smoke machine hit the market in the mid-'90s. Since then, of course, evaps have developed into today's enhanced systems, complete with a trouble code for a .040-inch leak (P0442) and one for a .020-inch leak (P0456)!

The evap evolution has been so rapid within the last eight years that the repair industry is embracing a new version of the general-purpose smoke machine. It's known, aptly enough, as an evap-approved smoke machine. The evap unit is a complete revamp of the existing smoke machine—a night-and-day difference in sophistication and test capabilities.

Remember, an evap machine does anything a general-purpose unit can. But it's also advanced enough to leak-test any evap system safely and accurately. In fact, industry experts now advocate general-purpose smoke machines for everything *except* evap testing. If you want to test everything *including* evap systems, they strongly recommend an evap-approved smoke machine. The current crop of evap machines range in price from about $2200 to $3000. Here's what you ought to know about them.

Characteristics of Evap-Approved Equipment

First and foremost, the vehicle manufacturers set the tone here by switching to smoke technology within the last several years. Using an evap-approved smoke machine isn't just recommended, it's now *required* by DaimlerChrysler, Ford, GM, Land Rover, Saab and Saturn. More approvals are pending.

Predictably, the automakers demanded that evap-approved equipment meet stringent safety, accuracy and performance criteria. In fact, DaimlerChrysler, Ford and GM collaborated with the equipment manufacturers to standardize what "evap-approved" actually means. The result is that you'll get the same, consistent leak test from an aftermaket evap-approved machine as you will from an OE-endorsed unit.

While some automakers use evap smoke machines built specifically for their tool and equipment programs, others require one that's readily available in the aftermarket. Evap-approved smoke machines are available from Champion Engineering in association with SPX/OTC, MotorVac Technologies, Snap-on and Vacutec.

Unlike traditional general-purpose smoke machines, the evap-approved units don't pump their own smoke. Instead, a compressed inert gas source connects to the machine and the gas pushes the smoke where you want it to go.

All vehicle makers but one require inert gas for evap leak-testing. All the companies that supply evap-approved aftermarket smoke machines strongly urge you to always use inert gas for evap leak tests. Nitrogen is the most commonly used inert gas. If you're leak-testing anything other than an evap system, compressed air works fine.

Smoke machine manufacturers say a good rule of thumb is that 300 cubic feet of nitrogen will do 300 five-minute evap system leak tests. Check with a local welding or industrial gas supplier about the cost of a bottle of nitrogen and a regulator. If you can't find a local

Who Pays for Smoke?

Wrench-turning people are, by nature, tinkerers. There's a little Edison in every technician. That's never been more evident than in the e-mails and notes I've seen on homemade smoke machines. Making your own smoke machine seems to be the new rite of passage into automotive adulthood.

Anyway, from the first time I covered this topic, guys have teased me, "What kind of fool would pay money to blow smoke?" Well, now that we've been around the method for eight years, let's revisit that question.

Back in the mid-'90s, Vacutec's Model 312 was *the* groundbreaking smoke machine. For many techs, the 312 was an introduction to smoke technology. Circa 1995-96, the typical street price on this unit was 1800 clams. What's more, competent shop owners I know had no trouble charging from .50 to .75 hour of labor (or more) to diagnose leaks with it. Others charged a flat fee of $25 anytime a tech rolled the machine out of the tool room.

Realistically, shops that believe in the technique are using it at least twice a day, five days a week. Let's apply that real-world $25 charge to a shop that's open 50 weeks a year. Ten uses a week at 25 bucks a shot times 50 weeks yields $12,500 a year from blowin' smoke.

Let's say a typical shop used the Vacutec 312 for only three years until it went out of production in '98. Three years times $12,500 equals $37,500. That's plenty of dough to pay the tech using the machine, not to mention to buy a newer smoke machine outright and continue making money!

Now factor in the hundreds of hours of diagnostic time and aggravation it saved the shop. Add in the number of additional leak-repair jobs—parts and labor—it generated in three years. Factor in the number of new and loyal customers you won over by diagnosing difficult leaks quickly and accurately when your competitors could not. All this came from an $1800 investment. Now who's the fool?

When it comes to convincing a doubtful or distrustful car owner, seeing is believing. When you take someone into the shop and show him smoke spewing out of a leak, he'll readily authorize the repair job.

Today, general-purpose smoke machines are available for less than $1300; occasionally you'll find one on sale for about $1000. If the Edisons out there have the time, ability and energy to duplicate the safety, performance and professionalism of a real smoke machine, more power to them. (You might want to factor in attorney's fees for proving that the contraption doesn't infringe on someone's patent!)

But while the Edisons tinker, the "fools" are already making money and winning customers.—*DM*

nitrogen supplier easily, contact PRAXAIR at 1-800-PRAXAIR (772-9247).

Since smoke machines first appeared years ago, many techs have instinctively and successfully used them to leak-check evap systems. More recently, automakers and industry experts have either forbidden this practice outright or are actively discouraging techs from doing it. Why? Because when a general-purpose smoke machine produces smoke, it also pumps air. Air contains oxygen. Mixing oxygen with evap system fuel vapors creates a potentially explosive situation.

For instance, say a vehicle's gas tank is very nearly empty when a tech begins pumping smoke into its evap system. This tech gets interrupted by a phone call. The guy in the next bay decides to start the engine to see where the smoke goes. When he does this, the fuel pump happens to arc amidst all those fumes and oxygen—*boom*!

Some guys argue that the risk of an evap-related fire or explosion is minuscule, but it takes only one accident to ruin your day. I'll leave the debate at this: Forewarned is forearmed.

Evap-approved machines produce a specially developed nontoxic smoke. This smoke has undergone extensive testing to ensure it won't harm the activated charcoal inside the evap canister. This smoke is also denser and whiter than that of the older smoke machines. Plus, it doesn't have an offensive odor.

Evap machines operate at a relatively low and very precisely controlled pressure that's *not* user-adjustable. Earlier I said that traditional general-purpose smoke machines produce about 1.00 to 1.50 psi. But an evap-approved smoke machine has a high-tech regulator that keeps operating pressure within 13 to 14 inches of water (.47 to .51 psi) ±1 inch. If you ever used a water-calibrated vacuum gauge—say, on a Ford VV carburetor—you know how sensitive inches of water is compared to the common inches of mercury.

The automakers requested this sophisticated, nonadjustable pressure control to eliminate or minimize the risk of someone damaging the evap system with excessive pressure. What's more, excessive pressure could create a false leak or force open a valve that's supposed to be closed.

All evap-approved machines have the UV dye feature that leaves a fluorescent deposit at the exact location of a leak. So this doubles your chances of finding even the most elusive evap leaks. If you miss the smoke, grab the UV-sensitive light you're using for a/c diagnosis and look for the UV deposit.

Another thing to know about evap-approved smoke machines is that all of them have a very sensitive flow gauge, which is essential to a really slick two-minute leak test I'll discuss in a moment. You've probably seen a flow gauge or flow indicator at some point—it's a transparent, vertical piece with a little ball inside it. Whenever smoke or nitrogen is flowing, the little ball moves upward. The higher this little ball moves during a leak test, the greater the flow and the bigger the leak. If the ball doesn't move at all, it means no flow/no leak.

Whatever you do, don't confuse an evap machine's flow gauge with the type used on some older general-purpose smoke machines. The gauges look similar but there's a monster difference

between them in price, accuracy and sensitivity. But industry experts say that comparing the cost and accuracy of older flow gauges to the ones on evap-approved machines is like comparing a yardstick to a micrometer! Presently, most techs are concerned with the .040- and .020-inch evap leaks. The evap machines' flow gauges are so sensitive they can accurately detect leaks smaller than .005 inch. That's pretty small when you consider that a human hair usually measures .003 to .004 inch!

The two-minute leak check I just mentioned may be one of *the* most valuable features on this current crop of evap-approved machines. Suppose you're diagnosing leaks on any evap system, particularly the enhanced one. On the enhanced system, the ECM may have set a leak code such as P0442 or P0456 (.040- and .020-inch leaks, respectively). You'd like to confirm quickly and accurately that these leaks actually exist. Or maybe you just repaired an evap system and you want to verify the system is tight without the hassle of running an evap monitor, etc.

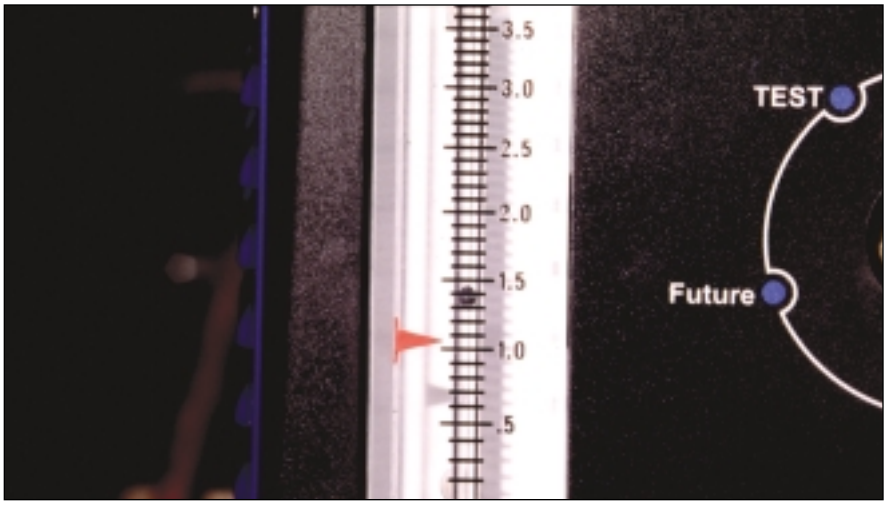

Photo: Dan Marinucci

You know this evap system definitely has a leak because the ball inside the flow gauge is above the checkpoint where the red flag is positioned. On the other hand, if the ball is below the red flag, the leak is smaller than the checkpoint.

Performing this quick check is easy: Turn the key on, engine off and use your scanner to close the vent solenoid valve. The purge valve is already closed because it's normally closed. Then connect an evap-approved smoke machine to the evap system's service port or the appropriate test point. Select the de-


Photos: Glenn Richardson

This leak on a Ford evaporative emissions fitting shows why an evap-approved smoke machine gives you twice the opportunities to pinpoint a leak. First, the leak creates a smoke signal (left photo). If somehow you overlook the smoke signal, the machine's UV dye will also mark the leak (green deposit, right).

sired "checkpoint" on the smoke machine (.040 or .020 leak) and watch the ball inside the flow gauge. When the ball comes to rest, slide the little red flag on the flow gauge alongside the ball. The flag's position now marks the actual flow caused by the .040 or .020 leak—whichever checkpoint you chose.

Next, move the smoke machine control to the Test position, fill the evap system with nitrogen and watch the flow gauge again. If the ball drops below the red flag, there's a leak, but it's smaller than your checkpoint. If the ball remains above the red flag, this is a serious leak that will trigger a trouble code because it's greater than the checkpoint—greater than .040 or .020 inch. If the little ball hangs high, start pumping smoke into that system and look for smoke signals or a UV dye deposit somewhere.

However, if you fill the system with nitrogen and the flow gauge ball drops to zero, the system is tight because no nitrogen is flowing. Remember, the higher the gauge ball rises, the larger the leak. Considering the aggravation many techs have had with enhanced evap system leaks, this quick go/no-go leak test will save countless headaches.

If a new, smaller evap system leak value is required in the future, the current evap-approved machines are updateable to accommodate another checkpoint, such as .010 inch.

A flow gauge is invaluable for a vari-

ety of other quick tests. For example, many evap solenoid vent valves are prone to intermittent sticking. Most of these valves are exposed to the elements because they're mounted under the rear of the vehicle. So the evap system may test good one day but the car may come back in a month with a MIL light on and another evap code because the vent solenoid valve stuck again.

Suppose you can command this solenoid on and off (valve closed or open) with your scan tool. Using an evap-approved smoke machine, pump smoke into the system and then operate the vent solenoid with the scanner. When the scanner says the vent is open, smoke should pour out of the vent in the rear of the vehicle. If watching the rear of the car isn't practical, watch the flow gauge on the smoke machine instead. When the vent solenoid is open, the flow gauge ball should jump up, indicating flow. When you close the vent solenoid with the scanner, the smoke should stop flowing out of the vent and the ball should drop to the bottom of the flow gauge, indicating no flow. Easy?

Just because the solenoid clicks and the scanner display says the solenoid operated does not prove the valve actually opened or closed. But the smoke and the flow gauge will. Another good work habit is to open and close the vent solenoid valve 10 to 15 times while watching the flow gauge. It's not uncommon to see one of these solenoid valves intermittently stick or hang up during this test. Replace it if it sticks even one time.

Before I leave the topic of evap diagnosis, know that many leaks begin after a collision or after work such as a fuel pump R&R was done. For example, the collision damage cracked a small plastic evap part and it was overlooked at the body shop. Of course, it's often very difficult to visually spot this kind of damage. Or, a careless tech may have kinked a seal or gasket on top of the gas tank when he finished up the fuel pump R&R.

I can't help but recall the conclusion I reached in that leak-detection story back in '95. Referring to the original smoke machine, I said, "...the Vacutec seems to be limited only by your imagination and resourcefulness." The same holds true for smoke machines today, plus your equipment choices now are much broader.

Last but not least, you have to decide if you want to stick with a general-purpose machine and forego evap testing or invest in a total-test concept with an evap-approved unit. If you charge accordingly, blowin' smoke makes you money. M

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