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Last time, we introduced you to the basics of vehicle emissions and fuel-economy certification and the complex processes involved. In Part II, we'll explain the certification tests themselves, the final certification process, and the resources—people and facilities—required for every U.S.-market automaker to get it all done.

## THE TESTS

Once the worst-case emissions-performance vehicles from each test group have been established, each is taken through a standard battery of certification tests. (A test group is a set of vehicles with essentially the same engine and emissions control system.) The EPA's original rules required just two standardized tests: the 42-minute Federal Test Procedure (FTP), which simulates stop-and-go city driving, and a 13-minute highway test that approximates gentle highway driving up to 60 mph.

New requirements in the mid-1990s added three more: a US06, hard-acceleration, high-speed, aggressive highway test with speeds up to 80 mph; an air-conditioning-on SC03 cycle that mixes city and highway driving at high ambient temperature and high solar load; and a Cold Test that is essentially the first 8.3 minutes of the FTP done at either 20 degrees or 50 degrees F, depending on whether it's for EPA or CARB.

"That's the tailpipe side of the equation," says Todd Fagerman, Ford's emissions certification manager. "There's also the evaporative emissions side, which is looking at emissions that escape from places other than the tailpipe. There are several tests for that—a two-day test, a three-day test, a running-loss test at elevated temperatures, tests that measure vapors that escape during refueling, and "spit-back" tests to make sure fuel doesn't spit back during refueling.

"The two- and three-day tests actually take from five to seven days because several days of preparation lead up to them. There's a series of preconditioning events where the evaporative canisters are loaded and purged and the vehicle is driven and subjected to temperatures and conditions it would experience in the real world to get it into a representative state. Then it's parked in what's called a shed for the designated length of time and cycled through temperature variations to simulate what happens in a parking lot—cool in the morning, heating up through the day, cooling down overnight—and through the same







## Emissions and Fuel Economy Certification – Part 2

By Gary Witzenburg



## Test Patterns



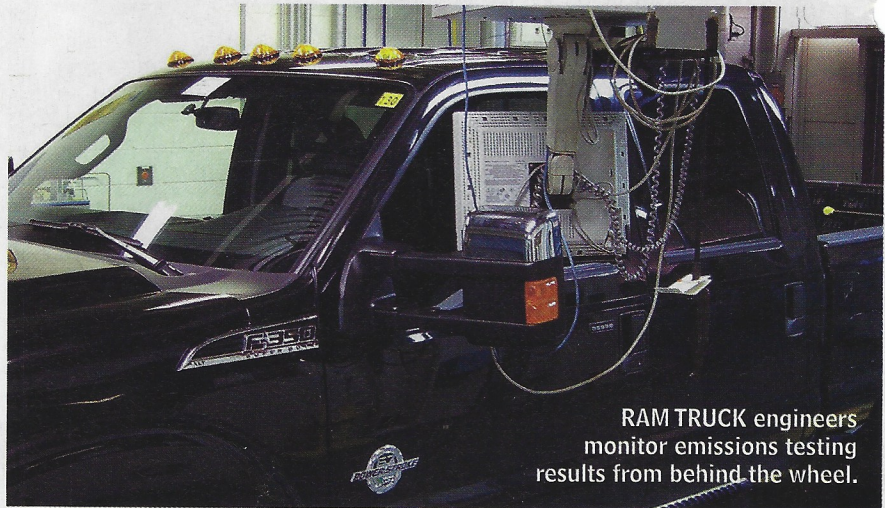
JAY COMBS/GM

cycle the next day. The shed captures any vapors that escape, which are then analyzed.”

“The federal and California tests are essentially the same,” adds Dave Garrett, GM’s director of emissions compliance and certification. “There are some slight, subtle differences in how you conduct them—the fuel you use or the temperature at which you run—but the test cycles are generally the same, though the standards may be different. It’s a complicated alphabet soup of standards. There are, in general, corresponding California standards to those for the EPA, but they don’t all mix and match very well. For federal vehicles, the standard is Bin 5. The equivalent standard in California is LEV [Low-Emissions Vehicle] II. There is also ULEV II, which is ultra-low emissions vehicle, SULEV II, super low emissions vehicle, and ZEV, zero emissions vehicle.”

### FINAL CERTIFICATION

Deadline for completion is roughly a month ahead of product launch. “At that point,” says Glen Heiser, Ford’s certification test technology manager, “we submit the official application, which contains all the test data, descriptive information about how our systems work, part numbers, and



RAM TRUCK engineers monitor emissions testing results from behind the wheel.

a lot more data that’s required as part of the process—to the EPA and CARB for certification. They review the application and, if we’ve done our job well, give us approval. In some cases, the EPA will decide to audit our testing and ask us to submit the vehicle so they can run a subset of our tests.” If there is a problem, the launch may have to be delayed, since uncertified vehicles can’t be shipped to dealers.

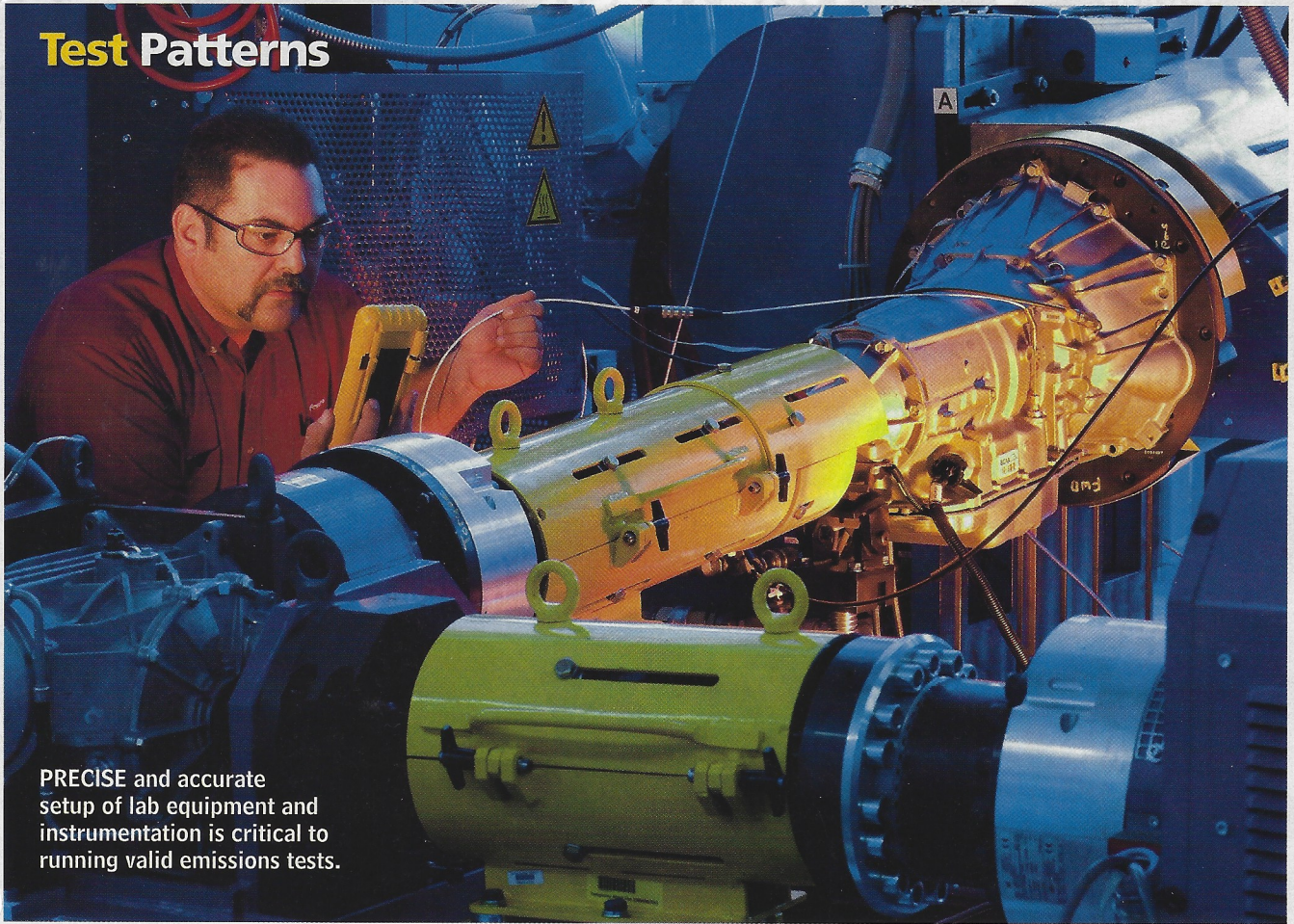
Unlike in Europe (and elsewhere), EPA and CARB require cars and trucks to meet the same emissions standards regardless of what fuel they burn, which

has become extremely challenging and costly for diesel-powered vehicles. “NOx control is very difficult on a diesel engine,” Garrett affirms, “particularly one that’s heavily loaded and has a relatively low power-to-weight ratio. Because the engine has to work harder, it puts out a lot of NOx, and the emissions-control systems managing that have become sophisticated and expensive.”

“The other piece we haven’t talked about,” adds Rich Bell, Ford’s compliance and fuel economy engineering manager, “is on-board diagnostics: demonstrating that your electronics system can monitor



## Test Patterns



**PRECISE** and accurate setup of lab equipment and instrumentation is critical to running valid emissions tests.

itself and appropriately indicate faults so the consumer gets the vehicle repaired as soon as possible.”

As we know from unhappy experience, when something isn't right, a Check Engine or Service Soon light tells us our vehicle needs attention. “That way,” Bell says, “the EPA and CARB are assured the vehicle is not operating in excess of [legal] emissions for long.”

To meet model-year 2011 emissions standards, most diesel light trucks will require after-treatment systems similar to the complex mult catalyst ones on current, expensive diesel-powered German luxury cars, which use a refillable liquid called urea to help cleanse their exhausts. And such ultra-tough requirements will soon extend up through heavy-duty trucks as well.

“The way the EPA is embarking on regulating fuel economy for heavier and heavier vehicles all the way up to Class 8 line-haul trucks,” Bell continues, “we'll likely see CAFE-like requirements extend up through everything anyone can imagine building, including chassis cabs. It will get really complex really fast. They're starting that process early next year and have already begun talks with vehicle and engine manufacturers.”

### RESOURCES

Garrett says GM has a fleet of about 100 vehicles dedicated to emissions and fuel-economy testing to cover its entire product portfolio. His 40-strong staff, which does not include product engineers or the staff at GM's Emissions lab, plans and manages the complex web of certification tasks.

He adds that GM spends more than \$2 million a year on certification fees to the EPA and CARB: “We pay for our punishment. We have 60 to 70 test groups each year and pay about \$35,000 each to certify with the EPA, depending on the mix and where the standards are. Then California bills us. They take the total cost of their certification programs and the total number of vehicles sold in the state that year and allocate [that cost] per manufacturer. Our certification fees to California last year were about \$1.2 million.”

Ford's Bell provides another perspective on the scope of his job: “We run about 30,000 tests a year in our Allen Park [Michigan] test lab, which includes a staff of about 100 people. Eighty to 85 percent are development, 15 to 20 percent are related to either emissions or fuel economy certification,” he says.

Michael Sherman, Ford's correlation compliance and analysis supervisor, points out that the Allen Park facility has 26 chassis-dynamometer emissions test sites. “Of those, seven are environmental, one altitude, two solar, and two running-loss. We currently have four diesel emissions sites; we recently added a separate system for gasoline direct injection; and every cycle typically requires special test equipment. For evaporative emissions, we maintain a dozen sheds, plus separate facilities for the on-board vapor recovery and spit-back tests. We also have a separate research facility in the U.S., plus our engine and transmission dynamometers.”

If you get the feeling emissions and fuel-economy testing and certification have evolved into expensive and time-consuming pieces of the overall product development puzzle, you're right. There's no question ultraclean emissions and ever-improving fuel efficiency are good things, but a relentless regulatory culture demanding continuous improvement beyond what's reasonable and affordable is not.

“Every time there's a major change in the regulations,” says GM's Garrett, “we have a major addition to our building.” Will enough ever be enough? **TT**