

In-Depth Analysis, Testing Yield Cause of High Hydrocarbon Failure

By Michael Zabik and Thomas Levasseur

Hydrocarbon (HC) failures are fairly common, especially in pre-OBD II vehicles. Many HC failures are easy fixes. Ignition-related failures, for example, are fairly easy to repair, as are oil consumption issues, dirty injectors, and simple vacuum leaks. Something as complex as an electronic fuel control issue, on the other hand, may be difficult to repair.

Most registered repair facilities have done a great job isolating and repairing HC failures, and fixing them right the first time. But what happens when there's an HC failure you cannot isolate? More specifically, could an emissions-control device actually cause an HC problem while not impairing drivability? Yes, definitely.

This is a story of a 1994 GMC Vandura with a 305 V-8, throttle body fuel injection, and 95,930 miles on the odometer. This vehicle had failed the emissions test for high HC. A registered repair shop performed all normal diagnostics, but could not pinpoint the problem. The shop then sought the assistance of Agbar's West Springfield Diagnostic and Training Center (DTC).

First, we ran a Mass 99 diagnostic trace to confirm the failure. As you can see on the report, the HC was very high at the beginning of the "cruise" and at the deceleration portion of the drive trace. Carbon monoxide (CO) and nitrogen oxide (NOx) were low.

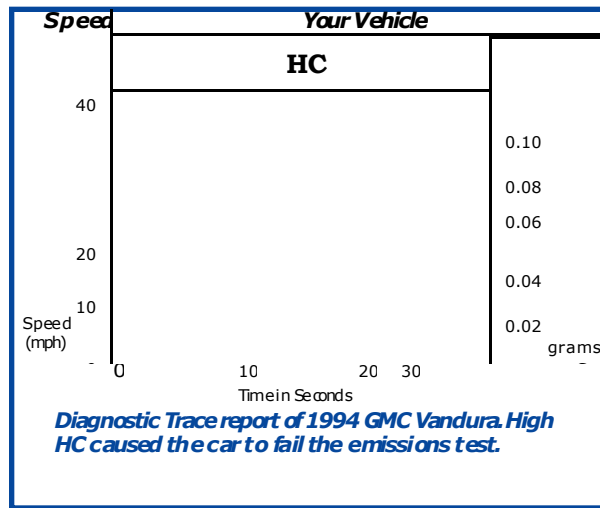
We then performed further diagnostics using the SPX EXXAM. This equipment enabled us to drive the vehicle on the dynamometer and watch the emission readings firsthand. (It uses concentration as opposed to grams per mile.) We were able to confirm that, when letting off the accelerator, the HC went very high and CO stayed low, a sign of a possible external vacuum leak.

When decelerating any vehicle, the CO should increase slightly because the throttle is closing rapidly, blocking off any air coming into the engine. This is true even on electronic fuel control vehicles. With this vehicle, the CO did increase slightly, but the HC was the major concern.

We went on to check for vacuum leaks and to inspect the vacuum lines to verify that they were routed correctly. We wanted to be sure, also, that the vacuum hoses were not excessively brittle and cracking. And we checked the PCV system to verify that this, too, was working as intended. All of these items were functioning in accordance with manufacturer's specifications.

There were no external vacuum leaks. So it was time to re-evaluate the condition.

Looking at the initial results, HC spiked right at the deceleration curve. This would make one think it could be an oil consumption issue — in other words, faulty intake valve seals or faulty guides



and seals; either would have the same basic effect. There was only one difference in this problem: CO.

Although CO was within specifications, it did spike to .6 grams per second at approximately 23-25 seconds of the drive trace. Because the CO spike occurred in the drive trace, we decided to look into something else that could be causing this condition at idle: EGR operation.

Why the EGR?

The EGR valve has a sole purpose: to reduce NOx emissions by "injecting" exhaust gases back into the intake manifold. It uses a valve, which is mounted on the intake manifold

and has a port from the valve to the intake. On the other side of the valve is a port from the exhaust manifold, which routes exhaust from the exhaust manifold to the other side of the valve.

Exhaust is a "non-reactive," or inert, gas when it comes to combustion. When the EGR valve opens, it allows exhaust to enter into the intake manifold. This exhaust gas will actually take up space and prevent oxygen from getting into the combustion chamber. Because the exhaust is inert, is taking up space and is preventing more oxygen from entering the combustion chamber, the combustion temperatures will drop. In theory, the intake charge becomes richer if the oxygen is displaced.

This valve needs to be controlled.

If manifold vacuum were to be used on this valve, it would be open at a low speed and the engine would stall. Why? The throttle plates are closed, and, therefore, not as much oxygen is getting into the engine. Besides, the engine is actually richer running at idle because the throttle is closed. Rich-running engines run cooler.

With the throttle open, the EGR valve is in operation, using ported vacuum. The engine is at a leaner condition because more air is entering the engine, causing a leaner mixture and higher combustion temperatures.

Another control is using a thermostatic vacuum switch. This prevented the ported vacuum supply from getting to the valve when the engine was cold. If vacuum did get to the valve on a cold engine, the engine would stall. It's a situation, again, of an overly diluted engine with little oxygen getting in to it. *The end result would be more fuel than air, causing a rough idle condition and a misfire.*

Over the years, technology has changed and manufacturers have developed different devices to apply EGR, which was the case with the '94 GMC Vandura brought to the West Springfield DTC.

General Motors used backpressure EGR valves - two different types — throughout the 80s and some in the 90s. The first type was a positive backpressure EGR valve, a dual diaphragm valve. The stem of the valve was hollow and allowed some of the exhaust gases

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into the stem up to a primary diaphragm. When the exhaust backpressure would build up, the pressure would push on a diaphragm, closing off a vacuum bleed. When the throttle allowed ported vacuum to occur, the ported vacuum would allow the secondary diaphragm to lift the EGR valve open. When the throttle gets released, the backpressure decreases, allowing the primary diaphragm to release, and opening up the air bleed to the secondary diaphragm.

The other pressure EGR valve GM used was a negative pressure valve, which operates similarly to the positive pressure EGR valve. Again, it has a hollow valve stem and a double diaphragm valve assembly. The primary diaphragm controls a vacuum air bleed similar to the positive pressure valve. This one works slightly differently: It relies on a low pressure or vacuum in the exhaust system. Every time an exhaust event occurs in the manifold, the gases start to expand and cool. This causes a low pressure, or vacuum, as the exhaust travels down the pipe.

The negative pressure EGR valve relies on that vacuum to operate the valve. During acceleration or moderate cruising conditions, low pressure will pull on the primary diaphragm and close off the air bleed in the EGR valve. When ported vacuum is applied, the secondary diaphragm will be sealed and the valve will

open. Remove the vacuum to that primary diaphragm, the air bleed becomes open and the EGR valve will close.

Carbon build-up occurs frequently in both of these EGR valves. Remember, the valve stem is hollow and allows either kind of pressure to activate these valves. If the valve stem gets restricted, the primary valve will be prevented from releasing. Thus, it will not allow the vacuum to purge from the secondary diaphragm, causing the valve to stick open, and allowing exhaust gases to enter the engine at idle.

After following the test procedure from ALLDATA, we discovered that the valve was, indeed, at fault. The primary diaphragm was restricted. This caused the valve to bleed down slowly, triggering a misfire during deceleration. It also caused the vehicle to fail the emissions test with both high HC and a CO spike.

After replacing the valve and verifying that all the ports were clean, the vehicle was retested and passed the emissions test.

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