EASTERN CATAYLTIC – TECHNICAL NOTE:

The Misleading Nature of the PO420 Code

By Ken Schafer Jr.

© Reproduced with permission from Undercar Digest.

For subscription information call 800-274-7890 or visit www.mdpublications.com.

Upon the arrival of the Onboard Diagnostics II (OBD-II) system, I remember thinking to myself that this new system was going to be the greatest thing to happen to vehicles since I had started working on them. Now all I needed to do was plug in a scan tool, since all vehicles would have the same data-link connector (DLC) much to my delight again, and the car would tell me what was wrong with it.

Sadly, it was only a few weeks later that I learned that this new system was still only a guideline and not a complete diagnosis. Throughout the years, after the start of OBD-II, it has become more and more accurate, but it still requires a bit of investigating after retrieval of the diagnostic trouble codes (DTCs). The P0420 code is no different.

Here is a scenario: A customer pulls into the shop and says, “My check-engine light is on.” I tell them that I will scan the vehicle and find out what the problem is. Once I hook the scan tool up and navigate through the setup menus and click on display codes, I see P0420. Then I click the display code data and the scan tool says “Converter efficiency below threshold.” I crane my head out of the driver’s seat and yell to the manager that the vehicle needs a converter. This may not be true, as further diagnosis is necessary.

From here on, I will try to explain some of the more-general steps I would take when diagnosing a converter with a scan tool. I will stay away from any finer points, as there are variances from manufacturer to manufacturer, but using these steps as a guideline should help to properly diagnose a catalytic converter.

Upon displaying the codes, first be sure that the P0420 is the only code present; if not, diagnosis of the other codes is necessary, as they may be causing the P0420 code. The reason for this is that the converter is the end result in the OBD-II diagnostic. Basically, if there is a
problem with one of the sensors in the engine or exhaust, it can cause either too much or too little fuel to enter the engine.

If the engine is getting too little fuel it causes a lean condition, which raises combustion temperatures and, in turn, raises exhaust temperatures. Since converters operate properly only between certain temperatures (900-1,400° F), extreme temperatures lower the efficiency of the catalyst and can trigger the P0420 DTC. At temperatures above 2,100° the catalyst will begin to melt down, permanently destroying the catalyst *(see Figure 1).*

![FIGURE 1: Melted catalyst](image)

Too much fuel does two things. First, the excess fuel entering the exhaust can coat the catalyst, cooling it as well as protecting the precious metals (which cause the catalytic reaction). This will last until the second problem happens: A spark enters the converter and ignites the fuel, at which point it turns into a secondary combustion chamber, destroying the catalyst *(see Figure 2).*

![FIGURE 2: Burned catalyst](image)

Once all the other DTCs are fixed, clear the codes and start the engine. Warm the engine until the water temperature is stable. Then, increase engine speed for about
three minutes, usually between 2,500 and 3,000 rpm; this will help the catalytic converter light off. After this, look at the wave forms between the front and rear O2 sensors. If the front O2 wave form is switching from high to low (rich to lean) and the rear is close to a straight line, the original converter should be OK. If the rear O2 sensor is mimicking the front one, the converter most likely took damage and may need to be replaced. A drive cycle may need to be completed and the converter monitor ready before you know whether the converter is good or bad. Follow the manufacturer guidelines for the correct drive cycle.

Once you have completed the drive cycle, or if when you first scan the vehicle the only code present is P0420, you should first look at the freeze-frame data. This will tell you the conditions that were present when the DTC was set (vehicle speed, engine speed, O2 readings and fuel trim, among others, but these four I have found most useful).

Looking at the fuel trim can tell you a lot without telling you too much. I know it sounds cryptic, but here’s an example: The only code is the P0420 but the fuel trim is high – usually above +8%, but this can vary, and one should consult a repair database for proper percentages. You already know that the engine is getting extra unmetered air into the intake and the ECM is compensating for this by dumping extra fuel into the intake. When this condition is present I look for any type of vacuum leak, intake leak or a dirty mass-air-flow (MAF) sensor that could be the cause of this problem.

If the fuel trim is low – usually below -8%, but this can vary the same as a high fuel trim – you know that the engine is getting extra unmetered fuel into the intake and the ECM is compensating by leaning out the fuel mixture. This is usually caused by either a stuck fuel injector or a bad fuel-pressure regulator.

Once the problem has been identified the repairs should be made, and after the warm-up process has been performed the vehicle should be tested to ensure that no other codes arise.

If the fuel trim looks within range it is time to look at the O2 values. The front O2 sensor should be switching from rich (over 600mV) to lean (under 300mV) and the rear O2 sensor, or converter monitor, should be a nice, smooth line with minimal variance in mV. When looking at the values of the O2 sensors pay particular attention to the switching rate of the sensors and be sure that neither the front nor rear sensor drops out or spikes for extended amounts of time. If either a slow switching rate or spike/drop-out happens, but the O2 then recovers and appears to be operating normally, the O2 sensor may be starting to deteriorate – or as a lot of people say, “It has become lazy” and may need to be replaced.
If you determine that the O2 sensor is lazy, remove it and check it for any type of contamination, usually by oil or antifreeze; if they are present, check the catalyst to ensure that it is not contaminated or poisoned (see Figure 3). If so, converter replacement will be necessary but not until the engine is repaired and the poisoning agent is no longer entering the exhaust, for this will lead to premature converter failure. If none of the above conditions are present and the engine is at operating temperature look at the front and rear O2 sensors. If the rear O2 sensor is mimicking the front one, the converter will most likely need to be replaced; there are only a few other easy things to look at.

FIGURE 3: Contaminated catalyst

After reviewing all the data and determining that there are no outside conditions causing the P0420 DTC, it is time to raise the vehicle and inspect the converter. I first look for any impact marks on the converter (see Figure 4) that may have resulted from road damage. If there are no marks on the converter I then inspect the body of the converter to see whether it is discolored, indicating that the converter has been overheated. If I see this, I usually consult the customer to find out whether they have had any other repairs to the engine that I am not aware of. This way I can ensure that a new converter will not suffer the same fate as the one that is on the vehicle. In most cases they would tell me that they have had other repairs done in the recent past and I would proceed with replacing the converter. If they tell me that they have not, I inform them that additional diagnosis may be needed. This is when I settle down and look over technical service bulletins (TSBs) and the diagnostic flow chart for the specific application; I will not go into these as they vary so much from application to application.
The final check I perform is to drop the faulty converter and inspect the insides again, checking for fuel, oil, antifreeze, or excessive carbon deposits (see Figure 5). If they are present, again further engine repairs may be needed before replacement of the converter. If not, I can be relatively certain that replacing the converter will solve the P0420 DTC and my customer will not be back in a week with that nasty P0420 code again.

The last thing I do, after replacing the converter with an approved quality aftermarket converter like those from Eastern Catalytic, is hook up my scan tool again and clear the codes, warm up the engine again, and watch the O2 sensors to see that the new converter lights off. Once I see this and the rear O2 sensor has a nice, smooth line (see Figure 6), I can release the vehicle with confidence that the problem has been fixed.
FIGURE 6: Waveform comparison

*Ken Schafer Jr. is Emission Certification Manager at Eastern Catalytic.*